

OPERATION/MAINTENANCE
AND
ILLUSTRATED PARTS MANUAL
For
CALAVAR SELF-PROPELLED CONDOR
MODELS 40, 48, 50, 56, 58, 68, AND 76



Calavar Corporation provides this manual for the guidance of all owners, operators, and servicing personnel in order to obtain the longest possible trouble-free service. It contains general data specifications; operating instructions; recommended lubrication procedures; vendor information and specifications; illustrated parts breakdown and a special section on safety.

Model _____

Serial Number _____

Date Delivered _____

CUSTOMER _____

NOTE: Additional copies of this manual can be provided through the Parts Department at Calavar. #92148

Series VIII - Commencing with Serial #4801, 2nd/3-82.

INTRODUCTION

The primary purpose of this manual is to provide the user with a thorough understanding of the proper operating procedures necessary to comply with the intended use of the **CONDOR®**, and to provide the information necessary to maintain and service the **CONDOR®**.

THE OPERATOR'S MANUAL MUST BE RETAINED ON THE CONDOR® AT ALL TIMES.

Do not attempt to operate or service the CONDOR® until you have read and understood all information provided in this manual. Familiarize yourself with the functions and operations of the upper and lower controls. A good understanding of the controls, their limitations, and their capabilities will maximize operating efficiency. The various decals attached to this CONDOR® also contain vital operational instructions. Read the decals before operating this CONDOR®.

It is YOUR RESPONSIBILITY to follow procedures while operating the **CONDOR®**. The manufacturer of this **CONDOR®** cannot control the wide range of applications that may be used in carrying out a variety of jobs. Therefore, it is THE USER'S RESPONSIBILITY to consider all personnel when making decisions regarding the **CONDOR®**'s intended use.

It is also YOUR RESPONSIBILITY to understand and obey all federal, state, and local regulations regarding the operation and use of aerial work platforms. A copy of the ANSI/SIA Manual of Responsibilities is attached for your use: ANSI/SIA A92.5-1992 is provided for Boom-Supported Elevating Work Platforms, and ANSI/SIA A92.6-1990 is provided for Self-Propelled Elevating Work Platforms.

Calavar Corporation reserves the right to modify, improve, add, and/or delete certain design features of its products without any obligation to incorporate new features into products previously sold. Our manuals are continually updated to reflect these changes.

***DO NOT ALTER OR MODIFY THIS CONDOR® WITHOUT PRIOR WRITTEN APPROVAL
FROM THE MANAGEMENT OF CALAVAR CORPORATION***

SERVICE & MAINTENANCE

Many of the parts used in the manufacture of the **CONDOR®** have specific properties, and the manufacturer recommends that replacement parts be purchased through Calavar Corporation in order to ensure the original integrity of the product. Repairs and adjustments should only be made by trained and qualified personnel. Please refer to the maintenance and parts sections of the Calavar Operation, Maintenance, & Parts Manual for information on service and maintenance of the **CONDOR®**.

NOTE: Please refer to the Calavar Parts section of the Operation, Maintenance, & Parts Manual for information pertaining to your **CONDOR®**.

SELF-PROPELLED CONDOR
PARTS AND MAINTENANCE MANUAL

INTRODUCTION

The function of the Parts and Maintenance Manual is to first provide the Customer with a complete and up-to-date Parts Manual covering all models presently in production and second, to aid in ordering the correct parts. If used properly, it will provide the Customer with a source of information that will aid in solving quickly and inexpensively the bulk of maintenance problems.

Under the various sections called out in the index, Calavar has included all the specification sheets from the manufacturers of component parts that make up the Condor, as well as a general troubleshooting guide directed solely to the Condor as a completed unit.

Throughout this manual reference is made to "unit serial numbers", and the use of this number when ordering parts will assist our Parts Department in giving you prompt and accurate service. The use of correct serial numbers and part numbers will also expedite completion of warranty claims sent to Calavar. Serial numbers should also be used at all times in phone conversations to Calavar's Service Personnel.

This manual has been produced as a valuable tool for our Customers. It is in your best interest that time be spent to read and understand all the sections in this manual.

Calavar has included a special section that deals with the safe operation of the self-propelled Condor, as well as information about certain items that must be inspected periodically to ensure a safe operating unit.

CALAVAR SELF-PROPELLED CONDOR
MODELS 40, 48, 50, 56, 58, 68, and 76

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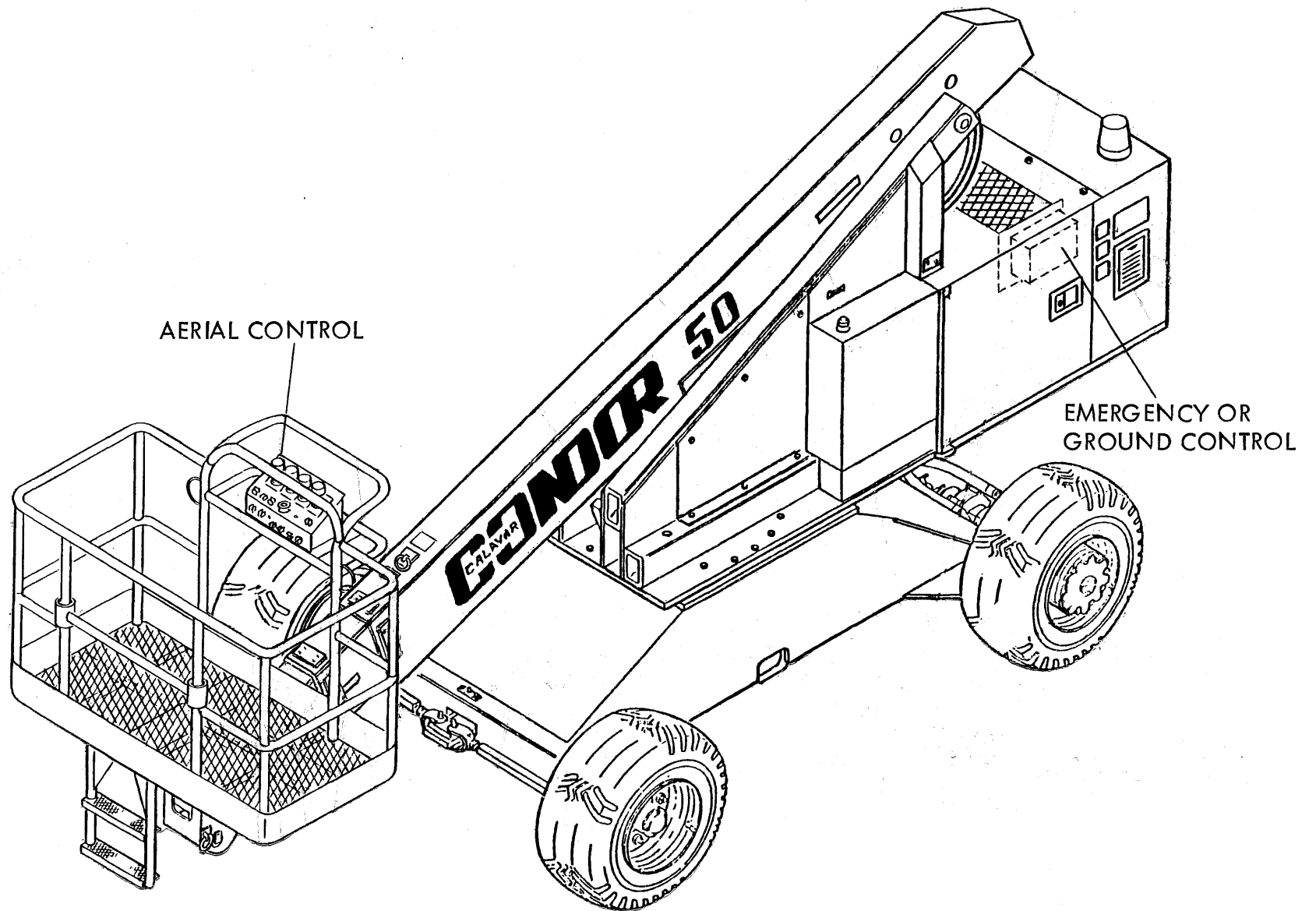
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Condor Operation and Safety



IMPORTANT

UNLOADING INSTRUCTIONS FOR THE SELF-PROPELLED CALAVAR CONDOR

1. BEFORE UNLOADING THE CONDOR, INSPECT FOR ANY PHYSICAL DAMAGE. NOTE ANY SUCH DAMAGE ON THE FREIGHT BILL AND REPORT SAME TO THE CARRIER.
2. CAUTION: The weight of the Condor ranges from approximately 12,000 lbs. to 23,000 lbs., and must be unloaded on a sturdy ramp.

<u>Model</u>	<u>Approximate Weight</u>
40	15,000 lbs.
48	12,000 "
50	15,000 "
56	15,000 "
58	23,000 "
68	23,000 "
76	23,000 "

If possible, select a site for unloading the unit that is suitable for making the installation check-out and inspection. A procedure form has been provided and must be completed before putting the Condor into service.

3. Operating instructions are located on a placard on the ground control side of the counterweight. Before starting the engine, check out the items as instructed on the placard and then proceed to operate the unit following the Check Out Instructions.
4. If the work platform was removed for shipment, it should be replaced prior to unloading. This provides a safe place from which to operate the Condor.

NOTE: Grasp the control handle knob as if it were a ball, squeezing the fingers will lift the bottom side of the control knob. This unlocks the control handle so that it can be moved in either direction. When released and brought back to neutral position, it will again lock.

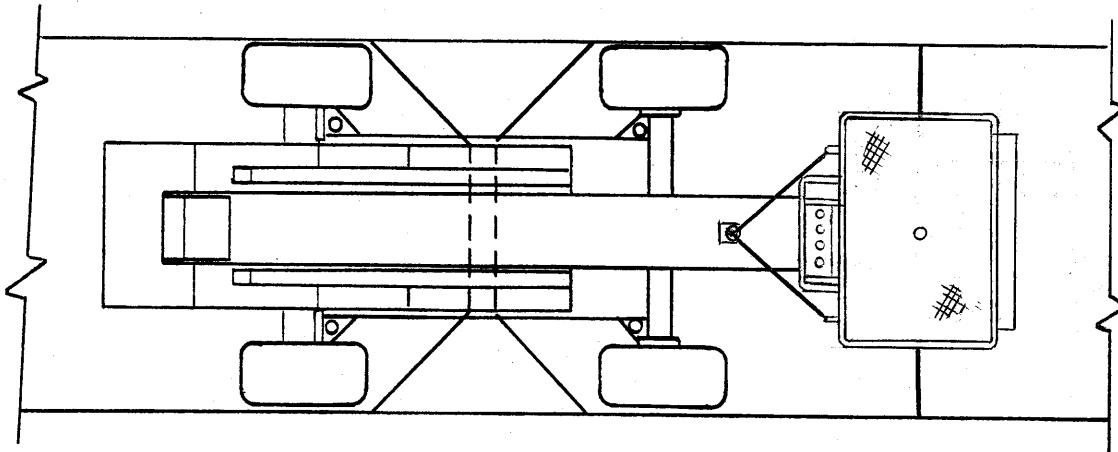
CAUTION: The lift controls are proportional type, with the speed of movement dependent on the position of the control lever. Controls should always be moved gradually. The normal driving position for the Condor is the counterweight over the drive wheels, and the controller movement is based on this configuration. When the boom is positioned over the steering end of the unit, the drive and steering controls will be reversed. Try each control momentarily to orient yourself on the direction of operation.

5. CAUTION: Before driving the unit down the ramp, test the automatic braking system by moving the unit slightly back and forth and see that the brakes apply each time the drive control goes back to neutral position. Move the unit on the truck or trailer and down the ramp approximately a foot at a time allowing for steering corrections to be made. Keep unit in alignment with the carrier and the ramp during the unloading procedure. It may be necessary to elevate the boom slightly to clear the ground as you proceed down the ramp.
6. All Condor models are equipped with a slope sensing device which has been incorporated into the system to indicate a 5° out-of-level condition. This safety system is operational only when the boom is above horizontal or at minimum extension. This device will automatically cancel all boom functions at both control stations when the unit is subjected to an out-of-level condition of 5° or more. An indicator light located in the aerial control console will also warn of this condition.

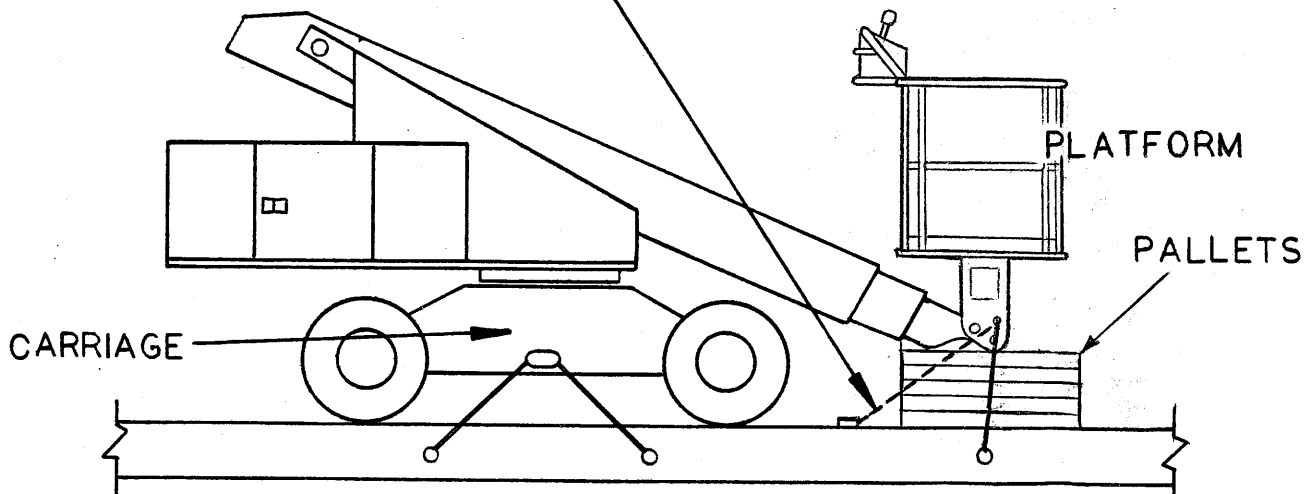
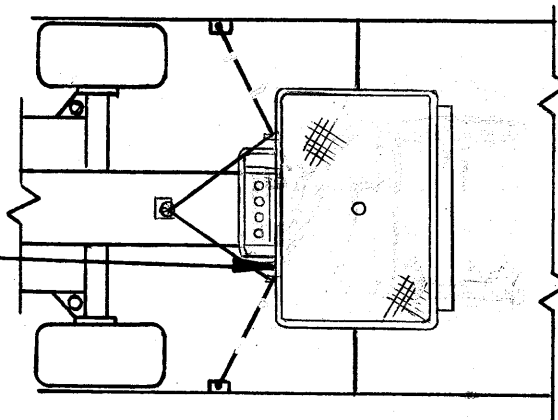
Once unit has reached an out-of-level condition of 5° and boom functions are inoperable, the operator may at his option, correct the situation normally by reversing drive direction, or by selecting an alternate route.

The slope sensing device is a safety system and must not be disconnected. Should this system be found inoperative, the unit must be grounded and must not be used until this system has been repaired.

FACTORY RECOMMENDED TRANSPORTING DIAGRAM



ALTERNATE PLATFORM
HOLD-DOWN



CHECK-OUT INSTRUCTIONS

The following instructions are a step-by-step procedure for checking out the self-propelled Condor, while at the same time, acquainting operating personnel with its operation. This procedure will not take over an hour and is time well spent to give both operating and maintenance personnel a better understanding of the operation of the Condor and also to provide an opportunity to acquire experience in the operation of the self-propelled Condor.

Prior to placing the self-propelled Condor into service, a full check-out of the unit should be made and the Installation Inspection Report completed and returned to the factory. Each unit has undergone a thorough Quality Control Inspection and each unit leaves Calavar in a first class condition. Unfortunately, damage in transportation may occur and you should be aware of such damage and make a note on the consignee copy of the freight bill. Calavar Corporation is not responsible for damage to units in transit.

1. Visually inspect all parts of unit that are exposed. Check for loose nuts, bolts, damaged hydraulic lines, broken wires or structural damage.
2. IMPORTANT! Check tire pressure. Pressure must be correct before operating. Do not over inflate. Correct psi is stenciled on both sides of the carriage.
3. Check hydraulic oil level---add Dexron II A.T.F. oil if required.
4. Fill gas tank, use regular gasoline only.
5. Check battery with an hydrometer. Battery must have a full charge.
6. All hydraulic valves are located on panel inside turret and are exposed by removing the inspection panel. Remove and replace this panel for visual inspection of turret compartment before placing unit into service.
7. Turn on master switch at ground station located inside locking access door. Depress Start Button and allow engine to warm up at idle. After unit has warmed up and with Ground/Aerial Selector Switch in ground position, unit can now be operated by activating switches marked BOOM UP, BOOM DOWN, TURRET ROT - LEFT OR RIGHT, and BOOM EXTEND OR RETRACT. Stop button will kill engine with a momentary touch only. It is not necessary to turn master switch off between running operations. This switch only provides the operator with a means of electrically locking unit.
8. With Master Switch ON, switch to AERIAL POSITION. Unit can be started or stopped from AERIAL POSITION. Position unit in an area that is free from any overhead obstruction. Lift bottom of Controller Knob for BOOM UP, push slowly to the UP position and raise boom about six (6) feet. When released, the controller will return to neutral position automatically. Learn to operate controller slowly to obtain the smoothest possible operation.

9. The Condor has been designed to drive with the counterweight over the drive wheels. This configuration will provide the best traction and a familiar driving position.
10. The wheel drive has the following features:
 - A. There is HIGH/LOW speed selection (toggle switch) on the aerial control box.
 - B. In HIGH speed mode, the vehicle in stowed position has 0 - 3 mph speed capability (fully proportional).
 - C. In HIGH speed mode, no aerial functions can be operated (even if operator activates the controllers for aerial functions).
 - D. In LOW speed mode, the vehicle has a 0 - 1.5 mph speed capability (fully proportional).
 - E. All aerial functions can be operated only in LOW speed mode.
 - F. At no time can the operator shift from HIGH to LOW on-the-go. (i.e.: HIGH/LOW toggle switch can only be functional when controller for drive function is in the neutral position.)
11. Operate boom at HORIZONTAL position until you have familiarized yourself with the operation and how the controllers feel. The smoother you are with the controller, the smoother the unit will respond.
12. Gradually operate unit up to maximum elevation and extension.
13. All Condor models are equipped with a slope sensing device which has been incorporated into the system to sense a 5° out-of-level condition. This safety system is operational when the ignition system is energized. This device will automatically cancel all boom functions at both control stations when unit is subjected to an out-of-plumb condition of 5° or more. An indicator light located in the aerial control console will also warn of this condition. Once unit has reached an out-of-level condition of 5° or more and boom functions are inoperable, the operator may at his option, correct the situation normally by reversing drive direction, or by selecting an alternate route. Eventhough this is a safety device, it must not be considered as a failsafe system. The operator must use normal safety precautions when operating this equipment. The slope sensing device is a safety system and must not be disconnected. Should this system be found inoperative, the unit must be grounded and must not be used until this system has been repaired.



CALAVAR CORPORATION

Self – Propelled Booms and Scissors WARRANTY

Calavar Corporation ("Calavar") warrants to the purchaser that each new aerial work platform made by Calavar is free from defects in material and workmanship arising under normal use and service, in the case of major weldments (chassis, turret and booms), for a period of **5** years after the original shipment of the aerial work platform from Calavar's plant; and in the case of all other parts, for a period of **1** year after the aerial work platform is first placed in service or **two** years after the original shipment of the aerial work platform from Calavar's plant, whichever occurs first.

The obligation and liability under this Warranty is expressly limited to repairing or, at Calavar's option, replacing free of charge, at its factory in Waco, Texas or at an authorized repair facility designated by Calavar, the defective part. In no event shall Calavar or its suppliers be liable to the purchaser or any other person for transportation charges or for any incidental, collateral, special or consequential damages, including without limitation damages for loss of profits, loss of customers, loss of goodwill or work stoppage, claims by any party other than the purchaser, or any other similar damages or loss even if Calavar, its suppliers or its representatives have been advised of the possibility of such damages.

Parts claimed to be defective and for which repair or replacement is desired shall be returned transportation **prepaid** to Calavar's factory for inspection. This Warranty applies to replacement parts provided under the terms of this Warranty only for the remainder of the Warranty period applicable to the original purchase.

Any operation of the equipment beyond rated capacity, improper use or application of the equipment, substitution upon it of parts not approved by Calavar or alteration or repair of the equipment by any person not authorized by Calavar shall, at Calavar's option, void this Warranty. Calavar shall have no liability or responsibility for damages resulting from accident or the malfunction of equipment and components not supplied by Calavar.

No agent, employee, distributor, dealer or other representative of Calavar is authorized to modify this Warranty in any way. Accordingly, additional statements or presentations by any such representative, whether oral or written, do not constitute warranties by Calavar and should not be relied upon as limited warranties of Calavar, and no attempt, effort or promise to repair equipment by Calavar or any such representative at any time shall modify or extend this Warranty in any way. If the purchaser has used its own order form, no additional or different warranty terms contained in purchaser's form will be honored by Calavar. This Warranty covers only new and unused aerial work platforms manufactured by Calavar. Products or parts manufactured by others are covered only by such warranties as are extended to the purchaser by Calavar's suppliers.

This Warranty is in lieu of all other warranties, expressed or implied, including but not limited to warranties of merchantability and fitness for a particular purpose. Any applicable implied warranty shall be limited in duration to the warranty period.

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9200 SORENSEN AVE. • SANTA FE SPRINGS, CALIFORNIA 90670-2645 • (213) 946-6561 • TELEX 69-8378 • TELECOPIER (213) 946-2265

Self-Propelled Booms and Scissors WARRANTY

Calavar Corporation ("Calavar") warrants each new aerial work platform made by Calavar and bearing the trademark "Condor" to be free from defects in material and workmanship.

The obligation and liability under this Warranty is expressly limited to repairing or, at Calavar's option, replacing free of charge at its factory in Santa Fe Springs, California or at an authorized repair facility as designated by Calavar, any part proving defective under normal use and service within 180 days after said aerial work platform is first placed in service or within one year after the original shipment of said aerial work platform from Calavar's plant, whichever first occurs.

Parts claimed to be defective and for which repair or replacement is desired shall be, if requested by Calavar, returned transportation prepaid to Calavar's factory for inspection. Replacement parts provided under the terms of this Warranty are for the remainder of the Warranty period applicable to the aerial work platform in which they are installed as if such parts were original components of the aerial work platform.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR ANY PARTICULAR PURPOSE, AND THE OBLIGATION AND LIABILITY OF CALAVAR UNDER THIS WARRANTY SHALL NOT INCLUDE ANY TRANSPORTATION OR OTHER CHARGES OR THE COST OF INSTALLATION OR ANY LIABILITY FOR DIRECT, INDIRECT OR CONSEQUENTIAL DAMAGES OR DELAY RESULTING FROM THE DEFECT.

Any operation beyond rated capacity or the improper use or application of equipment or the substitution upon it of parts not approved by Calavar or any alteration or repair by others in such manner as, in Calavar's judgment, to affect the equipment materially and adversely shall void this Warranty. No representative of Calavar is authorized to change this Warranty in any way, and no attempt, effort or promise to repair equipment of Calavar either by Calavar or by any representative of Calavar at any time shall change or extend this Warranty in any way. This Warranty covers only new and unused aerial work platforms manufactured by Calavar. Products or parts manufactured by others are covered only by such warranties as are extended to Calavar by its suppliers.



CONDOR Self Propelled Booms and Scissors WARRANTY

TIME CONDOR Corporation warrants to the purchaser that each new aerial work platform made by TIME CONDOR Corp. is free from defects in material and workmanship arising under normal use and service in the case of major weldments, (chassis, turret, and booms), for a period of five (5) years after the original shipment of the aerial work platform from the plant of TIME CONDOR Corp.; and in the case of all other parts, for a period of one (1) year after the aerial work platform is placed in service or two (2) years after the original shipment of the aerial work platform from the plant of TIME CONDOR Corp., whichever comes first.

The obligation and liability under this Warranty is expressly limited to repairing or, at TIME CONDOR Corp.'s option, replacing free of charge at its factory in Waco, Texas or at an authorized repair facility designated by TIME CONDOR Corp., the defective part. In no event shall TIME CONDOR Corp. or its suppliers be liable to the purchaser or any other person for transportation charges or for any incidental, collateral, special, or consequential damages, including without limitation damages for loss of profits, loss of customers, loss of goodwill or work stoppage, claims by any party other than the purchaser, or any other similar damage or loss even if TIME CONDOR Corp., its suppliers, or its representatives have been advised of the possibility of such damages.

Parts claimed to be defective and for which repair or replacement is desired shall be returned transportation **prepaid** to the CONDOR factory for inspection. This Warranty applies to replacement parts provided under the terms of this Warranty only for the remainder of the Warranty period applicable to the original purchase.

Any operation of the equipment beyond rated capacity, improper use or application of the equipment, substitution upon it of parts not approved by TIME CONDOR Corp. or alteration or repair of the equipment by any person not authorized by TIME CONDOR Corp. shall, at TIME CONDOR's option, void this Warranty. TIME CONDOR Corp. shall have no liability or responsibility for damages resulting from accident or the malfunction of equipment and components not supplied by TIME CONDOR Corp.

No agent, employee, distributor, dealer, or other representative of TIME CONDOR Corp. is authorized to modify this Warranty in any way. Accordingly, additional statements or presentations by any such representative, whether oral or written, do not constitute warranties by TIME CONDOR Corp. and should not be relied upon as limited warranties of TIME CONDOR Corp., and no attempt, effort, or promise to repair equipment by TIME CONDOR Corp. or any such representative at any time shall modify or extend this Warranty in any way. If the purchaser has used its own order form, no additional or different warranty terms contained in the purchaser's form will be honored by TIME CONDOR Corp. This Warranty covers only new and unused aerial work platforms manufactured by TIME CONDOR Corp. Products or parts manufactured by others are covered only by such warranties as are extended to the purchaser by TIME CONDOR's suppliers.

This Warranty is in lieu of all other warranties, expressed or implied, including but not limited to warranties of merchantability and fitness for a particular purpose. Any applicable implied warranty shall be limited in duration to the warranty period.

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WARRANTY PROGRAM

Warranty is a function of a manufacturing company to back up the product it manufactures. It is a guarantee against defects in design and workmanship of components utilized in the product, and is offered for a certain period of time following purchase by a customer.

TIME CONDOR Corporation's warranty states, in general, the TIME CONDOR Corporation will replace free of charge, any components found to be defective within the time frame of the warranty period. There are exceptions to some components which are not the responsibility of TIME CONDOR Corporation. These will be outlined in other paragraphs.

The warranty policy and description are depicted on the attached printed policy. For your reference, the following is offered:

A. WARRANTY PERIOD

1. The Self-Propelled Boom and Scissor Warranty is one (1) year from placing the unit in service or two (2) years following shipment from TIME CONDOR Corporation, whichever comes first. In the case of major weldments (chassis, turret, and booms), the warranty period is five (5) years following shipment from TIME CONDOR.
2. The truck mounted unit warranty is one (1) year from shipment of the unit from TIME CONDOR's plant.
3. For parts sold thru the Parts Department, the warranty period is six (6) months from utilizing the component or placing it in service, or twelve (12) months following shipment from TIME CONDOR, whichever comes first, unless the part is furnished to correct a defective part on the original CONDOR® shipment still under warranty. No labor is paid under parts warranty.
4. Replacement parts provided under the terms of the warranty are for the warranty period applicable to the unit in which they were installed as if such parts were original components of the aerial work platform.
5. In addition to covering the parts replaced under CONDOR® warranty, TIME CONDOR will pay a dealer warranty labor rate, which is based on a percentage of your standard shop labor rate.

NOTE: The term "IN SERVICE" means that the warranty starts at the time the CONDOR® is first used for any purpose. An example: The dealer may have purchased a CONDOR® to have in stock, but may not use it. After three months, the CONDOR® is sold or the dealer decides to put the CONDOR® into its rental fleet. In this situation, the warranty period begins the day the dealer puts the CONDOR® into the fleet or when the CONDOR® is delivered to the end user.

The submittal of a warranty claim against a stock CONDOR® constitutes it as being "in service", initiating the warranty period.

B. PRE-DELIVERY INSPECTION SHEET (P.D.I.)

1. Each Self-Propelled Boom or ScissorCONDOR® shipped from TIME CONDOR's facility will have a Pre-Delivery Inspection (P.D.I.) sheet enclosed in the Safety Manual holder tube.
2. It will be the responsibility of the original recipient of theCONDOR® from TIME CONDOR, whether it will be the dealer or the end user, to complete this form and return it to TIME CONDOR's facility within 45 days from the date of receipt to set up the Warranty Account.
3. Failure to complete the P.D.I. sheet and return it to TIME CONDOR within the time frame given will result in voiding the Warranty on theCONDOR®.

NOTE: The form must be filled out completely, giving the name of the dealer, address, model number, serial number, person inspecting theCONDOR® signature, and date of inspection. (The date of inspection does not constitute the "In Service" date.)

C. ITEMS NOT COVERED

Some components are used on the machine which are not warranted by TIME CONDOR Corporation. However, these are warranted by the component manufacturer. Some of these are:

1. Engine: Manufacturers used include Wisconsin, Ford, Deutz, Isuzu, Kubota, Onan, Cummins, John Deere, and others. To apply for warranty on the engine, contact should be made with the engine manufacturer's dealer in your area. TIME CONDOR Corporation can advise you if you need assistance locating a dealer.
2. Tires and Batteries: These are normal wear items and are considered normal maintenance items. However, if they are found to be defective, contact can be made with the manufacturer's local dealer. **NOTE:** For international dealers where tires or batteries are not obtainable from a local in-country supplier, locally supplied tires or batteries can be used. Components must meet or exceed originally-supplied items. Copies of invoices for said items **MUST** accompany any Warranty Claims to receive parts credit.
3. Hydraulic Filters and Fluid: These are considered general maintenance and service items, and are not covered by warranty.
4. Other components: Products or parts manufactured by others are covered only by such warranties as are extended to TIME CONDOR Corporation by its suppliers.
5. Freight and Charges: The warranty does not include any freight, transportation, other charges, or the cost of installation or any liability for direct, indirect, or consequential damages or delay resulting from the defect.
6. Travel Time / Mileage: Travel time and the mileage to and from dealer facilities to CONDOR® location are not covered or reimbursable.
7. Troubleshooting: Troubleshooting is not covered or reimbursable. However, TIME CONDOR Corporation warranty will cover reasonable labor charges for the removal and replacement of defective components.

D. PROCESSING OF CLAIM

During the Warranty Period, should a component failure be encountered within the guidelines of the TIME CONDOR Warranty Policy, the following procedure is to be followed:

1. Upon identifying the defective component, the replacement can be obtained by:
 - a. Issuing an order to our Parts Department through normal channels, which entails your company being invoiced.
 - b. You may have previously purchased the part from TIME CONDOR for your stock and will utilize it for this replacement.

The above two methods will enable you to indicate on the claim the TIME CONDOR invoice number to substantiate the parts purchase and the amount to be credited.

- c. Although not recommended, you may purchase the part locally. When this is done a copy of the purchase order or receipt MUST accompany the claim. TIME CONDOR has the option to ship a replacement part at no charge if the local cost would be greater in lieu of issuing credit for locally purchased parts.
 - d. When parts are purchased from TIME CONDOR, part numbers with invoice numbers MUST be referenced in the appropriate section of the claim form.
2. Complete the Warranty Claim as noted in the "Warranty Claim Procedure" section. Provide as much information as possible to enable TIME CONDOR to thoroughly evaluate the claim and process it in the shortest amount of time possible.

NOTE: CLAIMS NOT RECEIVED BY TIME CONDOR WITHIN 45 DAYS OF FAILURE WILL BE DENIED

- -
 3. Provided no return parts are required and all the information has been verified, the claim will be processed and credit will be issued against your account.

E. RETURN AUTHORIZATION

1. If a component is found to be defective within the normal guidelines of the Warranty, a Warranty Claim Form must be completed.
2. It will be necessary for you to call the TIME CONDOR Service Department and request a Return Authorization (R/A) number. You will be asked for a Dealer Claim Number. As noted in Section 2, Item A, of the Warranty Claim Procedure, this is a number assigned by the dealer for the purpose of tracking the claim, as there may be more than one claim for the same **CONDOR®**. The R/A number issued must be logged in the appropriate section of the claim form, and the gold copy (R/A) of the form MUST be returned with the parts being returned.

NOTE:

**DO NOT SHIP ANY RETURN PARTS WITHOUT
A RETURN AUTHORIZATION (R/A) NUMBER**

Doing so may result in parts getting lost in the system and may delay processing the claim, or may cause denial due to the time element of the claim.

3. All R/A parts must be received at TIME CONDOR Corporation within 45 days from the date the R/A number was issued. Failure to do so will cause the claim to be denied.
4. All parts claimed under Warrantanty will be required to be shipped back to TIME CONDOR Corporation **FREIGHT PREPAID**. No freight collect shipments will be accepted.

NOTE:

Due to shipping charges and impart duties imposed on INTERNATIONAL DEALERS, these dealers will not be required to automatically return all parts.

TIME CONDOR Corporation requires that all parts claimed on a Warranty Form be retained by the international dealer for a period of no less than 180 days. After this period, if no instructions have been received form TIME CONDOR Corporation, the parts may be scrapped.

Should TIME CONDOR Corporation request any part be reumed, it will be shipped to our factory in Waco, Texas, frieght prepaid.

WARRANTY CLAIM PROCEDURE

INTRODUCTION

This procedure is offered to assist our Dealers in properly completing our Warranty Claim Forms. The more information supplied, the better TIME CONDOR Corporation can evaluate the problem and expedite processing the claim.

The form should be TYPED or completed LEGIBLY in ink. Several copies are utilized. Ensure that sufficient pressure is applied to make all copies legible.

PROCEDURE

NOTE: THE NUMBERS NOTED BELOW CORRESPOND TO THE BLOCK NUMBERS ON THE CLAIM FORM

1. Where to mail: P.O. Box for mailing claim, street address for R/A parts returns.
2. Claim information:
 - a. Dealer's Claim Number: This assigned number is necessary for Dealer and TIME CONDOR Corporation tracking purposes, since there may be more than one claim for the same unit.
 - b. TIME CONDOR Corporation Warranty Number: Do not write in this section. It is for Condor Div. use only.
 - c. Return Authorization Number: All parts replaced under Warranty MUST be returned to TIME CONDOR Corporation freight prepaid. Call the TIME CONDOR Corporation Service Department for Return Authorization Number. Parts returned without proper authorization and gold packing slip will not be accepted.
 - d. All dates pertinent to the claim and/or R/A are to be entered in the proper locations.
3. Dealer information: Supply the name of the company, address and name of the person submitting the claim. This person will be the contact if a discrepancy occurs, and will be referred to on all correspondence.
4. This section is provided to identify the unit: The date of delivery (date unit was received at your facility); In Service date (date sold to end user or date put into operation); Model and Serial numbers; type of Warranty, (A) Aerial Lift Warranty on a specific unit or (B) Parts Replacement, Warranty on a new part ordered and found to be defective.

5. Owner Information: Supply end user company name and address. If it is the same as the dealer's, write "Same".
6. This area is for part number(s) and description(s). It is VERY important that the TIME CONDOR Corporation invoice number(s) for which the part(s) were purchased be provided along with the amounts in order to properly process the claim. NOTE: All dollar amounts are to be in U.S. currency.
7. Labor Description: A detailed description of the failure along with the work performed is required in order to fully evaluate the hours of your claim and the amount TIME CONDOR Corporation will approve.
8. TIME CONDOR Corporation remarks: This area is completed by TIME CONDOR Corporation. A brief explanation and steps taken in the determination of approval or denial is provided here.

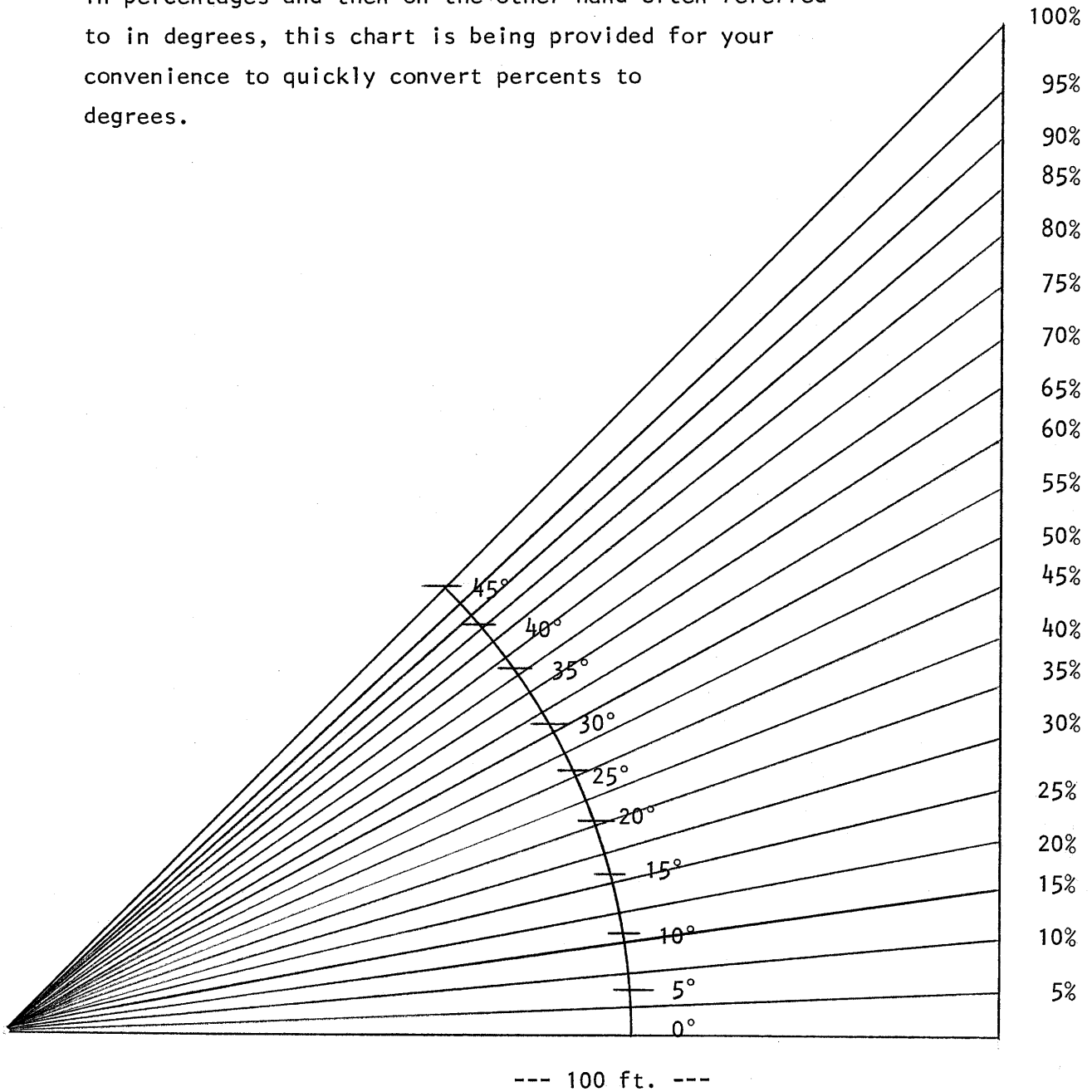
Upon completion of the form, remove the YELLOW copy for your records. Remove the GOLD copy (packing slip) and send it, along with the parts being returned under warranty. The GOLD copy MUST have the R/A number in the proper location and must be packed in with the parts sent back to Condor Div..

Mail the remaining copies to the TIME CONDOR Corporation P.O. Box block#1 for TIME CONDOR Corporation evaluation.

NOTE: CLAIMS NOT RECEIVED WITHIN 45 DAYS OF FAILURE WILL BE DENIED.

CONVERSION TABLE
DEGREES TO PERCENTAGE

Since the conversion of gradeability is often referred to in percentages and then on the other hand often referred to in degrees, this chart is being provided for your convenience to quickly convert percents to degrees.



HYDRAULIC SYSTEM

The hydraulic system for the CONDOR uses a John Deere pressure-compensated piston pump which is driven directly from the engine shaft. Flow from the John Deere piston pump is directly connected to the electrically-controlled hydraulic valves. These control valves, in their neutral or center position, have inlet flow passages internally closed-off to the cylinder ports as well as to the tank port. Because of this, when the unit is started, the system reaches the maximum pressure and causes the compensator to de-stroke the pump. Then the pump only delivers enough oil to make up for system slippages, and maintains the maximum pressure throughout the high-pressure system. The maximum system pressure thus depends on the compensator setting of the pump.

To avoid wasted horsepower, the John Deere piston pump remains at minimum pressure and minimum flow condition whenever all the controls are not being operated. This is achieved by use of the normally-open two-way solenoid valve (Figure 13, View A, Item 42). When any of the controllers are activated, the solenoid valve is energized causing the pump to go on stroke. The pump then delivers oil to the control valves building maximum system pressure immediately.

The following procedure will provide the mechanic with the necessary pressure settings and a step-by-step method to test and troubleshoot the hydraulic system and obtain the best possible performance from the self-propelled Condor. It is recommended that two properly calibrated pressure gauges (0-600 psi range and 0-5000 psi range) be used to set pressures.

Table 1 gives the basic information on the self-propelled Condor hydraulic system (pump, speed pressure, flow, and wheel drive components). In order to make the proper hydraulic adjustments on the various Condor Models, it is necessary to refer to Table 1.

The Condor Parts Manual, supplied with each vehicle, has service information on the Wisconsin Gas Engine (or Deutz Diesel Engine), John Deere Pumps, Berteau Proportional Control Valves, Racine On-off Solenoid Valves, White Hydraulic, Inc. Motors, Fairfield Torq-Hubs (or Borg-Warner Power Wheels) and W.S.I. Hydraulic Drive Motors. This information along with the complete component specifications should be referred to for a thorough understanding of how the various system components work.

To check main pump pressure, place 0-5000 psi gauge on the system pressure test port (Figure 11, Item 82). Start Unit. Switch to ground control and actuate a toggle switch. Hydraulic pressure should read 2150 psi. If pressure is somewhat higher or lower than 2150 psi, use the following procedure for making adjustment: Loosen pump compensator (Figure 13, Item 65) and turn adjustment screw counterclockwise to lower pressure. Turn adjustment screw clockwise to raise pressure. Once the pressure has been properly set, secure locknut on adjustment screw.

The main proportional control valve assembly (Figure 11, Item 25) is a Berteau four-spool valve bank. The spool valve functions, from left to right, are boom extension; turret rotation; boom lift; and wheel drive.

There are two relief valves located in the Berteau valve inlet section. The main relief valve (Figure 2, Berteau Service Manual, Item 5) is set at 2750 psi, and the control pressure relief valve (Figure 3, Berteau Service Manual, Item 10) is set at 300 psi. Both relief valves have been set at the factory, and these settings MUST NOT BE CHANGED.

Control pressure for the Berteau valve is taken from the pressure inlet port through a flow control valve (Figure 11, Item 16), having a fixed setting of 3.0 gpm at 300 - 500 psi. The pressure can be checked by installing a 0 - 600 psi gauge in the control system test port (Figure 11, Item 15).

Located above the Berteau valve bank is the MFP 10 micron filter (Figure 11, Item 11) for the control oil. Care must be taken when changing the filter element.

C A U T I O N

After a new element has been installed, fill the filter can with oil before replacing can and starting unit. This will prevent any possible damage to the filter element.

Located on the inlet cap on the Berteau valve is the control pressure inlet port (Figure 3, Berteau Service Manual, Item 14). This is an in-line filter, to provide additional filtration for the control oil. This filter should be removed, inspected and cleaned when the MFP Filter is replaced.

Located to the left of the Berteau valve bank is the three-spool Racine valve assembly (Figure 11, Item 36) for control of the steering and platform tilt functions and platform rotation option.

Inlet flow to the Racine valve assembly is controlled by a needle valve (Figure 11, Item 20) located on the inlet pressure line of the Berteau valve. This needle valve is set to deliver three to four gpm to the Racine solenoid valve bank assembly. To adjust needle valve, follow these steps:

1. Loose lock nut, turn valve counter-clockwise to open valve wide open.
2. Turn valve clockwise one turn, giving full signal to drive, unit should turn left or right on any surface the unit would be driven on.

If oil flow is too little, unit will have a very slow steering response.

If oil flow is too great, steering will react too quickly, resulting in possible damage to steering components as well as to the valve.

3. Once steering has been set, secure lock nut.

The drive and brake assembly are shown in Figure 4, Item 6. The W.S.I. Drive Motor (Figure 4, Item 6) includes a spring activated and hydraulic released disc brake package that is automatically released while driving. The drive motors are coupled to a planetary gear box (Figure 4, Item 1).

C A U T I O N

Care should be taken when checking and servicing of these components. Read vendor information pertaining to servicing.

Figures 4 and 4A show a Modular Valve, located in the carriage between the drive motors. It contains several features---a flow divider cartridge, a two speed feature, a flow control and check valve cartridge, another adjustable flow control valve cartridge, and an internal shuttle valve. This Modular Valve performs the necessary function of dividing the oil for slow speed travel with adjustable differential action to round corner, as well as diverting the oil flow for high speed. The shuttle valve (with check valve and flow control valve) provide brake release and application efficiently without an accumulator.

The standard self-propelled Condor is NOT BUILT TO BE TOWED. However, if it should become necessary to move the unit, and it cannot be done so under its own power, torque hub literature shows the reversible plates making the unit free-wheeling.

C A U T I O N

During free-wheeling, there are no wheel brakes. All necessary precautions must be taken to avoid accidents.

Because there are two separate hydraulic system pressures being supplied by the John Deere Pump, it is possible to trace which system is not working. (MAIN SYSTEM or CONTROL PRESSURE SYSTEM.) By placing pressure gauge on the main test port, (Figure 11, Item 79) a reading of 2150 psi should be noted.

If by checking the pressure setting no reading is obtained, check the pump stroke solenoid valve, (Figure 13, View A, Item 42) to be sure it is electrically energized. (Refer to the "Electrical System Specification.") If solenoid functions electrically, the valve should then be checked hydraulically. This valve is normally open and is closed electrically.

If the LIFT; TURRET ROTATION; EXTENSION; STEERING; TILT and PLATFORM ROTATION are inoperative and the pump pressures are properly set, use the following steps to isolate the problem:

1. Place 0 - 600 psi gauge on test port (Figure 11, Item 15).

2. There should be a pressure reading of 300 psi minimum (OIL HOT), 400 psi maximum (OIL COLD).

If this pressure is too high, possible damage may occur to pilot valve assembly.

If this pressure is low, functions will have a slow response. However, if control pressure is too low (150 to 200 psi), the Berteau valves will not function.

3. Valve, Part Number 21472, non-adjustable. Replace valve.

If unit should lose STEERING, TILT, and PLATFORM ROTATION, check needle valve (Figure 11, Item 20). Should only one function be inoperable, check electrical portion of manual.

TABLE 1: HYDRAULIC SYSTEM DATA

Condor Model	Pump Model	Pump Displ. Cu. In./Rev.	Pump Flow/Pump Speed	Maximum System Pressure PSI, or Compensator Setting PSI	W.S.I. Drive Motor Cu. In./Rev.	Wheel Gear Reduction
40	PR-24	2.4	19.5 gpm @ 2100 rpm	2150	4	FAIRFIELD Torq-Hub 35:1
48	PR-24	2.4	19.5 gpm @ 2100 rpm	2150	4	BORG-WARNER Power Wheel 29:1
50 56	PR-24	2.4	19.5 gpm @ 2100 rpm	2150	4	FAIRFIELD Torq-Hub 35:1
58 68 76	PR-24	2.4	19.5 gpm @ 2100 rpm	2150	4	FAIRFIELD Torq-Hub 54:1
OPTIONS: #21066 #21433 (Diesel w/spec. drive)	PR-24	2.4	19.5 gpm @ 2100 rpm	2150	6	FAIRFIELD Torq-Hub 54:1

12.

ELECTRICAL SYSTEM

Electrical schematic drawings are located in Section X of the Parts and Maintenance Manual and should be referred to for a better understanding of the Condor electrical system.

The Condor utilizes a 12-volt direct current system with a negative ground. All electrical components with the exception of the Proportional Control Valves operate directly from the 12 VDC source. The proportional control valves are energized at the ground control station through toggle switches which have a variable rheostat on the supply terminal. The rheostat drops the voltage to a level for continuous operation. The Aerial Control Station contains lever type proportional controllers capable of delivering the required proportional voltage to the valves through the entire movement of the controller handles.

NOTE: Refer to Section VII for troubleshooting the Electric System and for a thorough explanation of the system.

To prevent early problems and to aid in troubleshooting the electrical system, the use of an hydrometer will determine the condition of the battery. Although the battery may have enough charge to start the Wisconsin Engine, it may not have adequate capacity to operate the Berteau System. Check the specific gravity of the battery. An acceptable reading on a fully charged battery will read approximately 1,200 on an hydrometer.

The Ground Control Station is primarily an emergency control station. Anyone on the ground can transfer operation from the operator in the platform by switching the aerial ground toggle switch to the ground position. When in the ground position, lift, rotation, extension and retraction are controlled with momentary bi-directional toggle switches.

Each of the ground toggle switches, when activated, electrically energizes the pump solenoid valve which advances the pump from standby to a working position. With hydraulic pressure, the engine rpm is increased to 2,100. The function selected is now hydraulically and electrically energized and operational.

Proportional Speed Controllers used to control drive, lift, turret rotation, boom extension/retraction, are located at the aerial station. Bi-directional toggle switches are used for steering, tilt and platform rotation.

NOTE: See Honeywell Literature, Section VII, for details of operation and adjustment.

Engine start and stop at the aerial station and ground station are independent circuits. The Condor can be started or stopped at any time from either position. After the master switch has been turned on, depress start button. To stop takes only a momentary touch of the stop button.

NOTE: The engine stop circuit is considered a safety feature and must be maintained as a safety item.

To perform electrical checks, turn master switch on. Remove engine coil wire from coil and depress engine start button momentarily. This resets the main latching relay and will energize the entire electrical system.

NOTE: Watch ammeter for a discharge condition. Should a discharge reading occur, momentarily depress start button again, and continue this procedure until a no discharge condition prevails.

Install a volt ammeter in series on turret rotation, wire #21 or wire #22 at the pilot valve. Activating the ground control turret rotation switch will result in energizing the pump solenoid valve and send an electrical signal to the pilot valve through the volt ammeter. A reading of between 40 to 60 milliamperes would register. If there is no reading, reverse direction of the switch or controller. If still no reading, then check for voltage into switch or controller. Should there be voltage into switch and no voltage into pilot valve, then check for damaged or broken wire or connection.

The above example can be used to quickly troubleshoot any of the functions on the self-propelled Condor.

MECHANICAL AND ELECTRICAL CABLE ADJUSTMENT

FOR MODELS 4248, 5056, 6066 AND 50

HAVING DUAL CABLES FOR BOOM EXTENSION

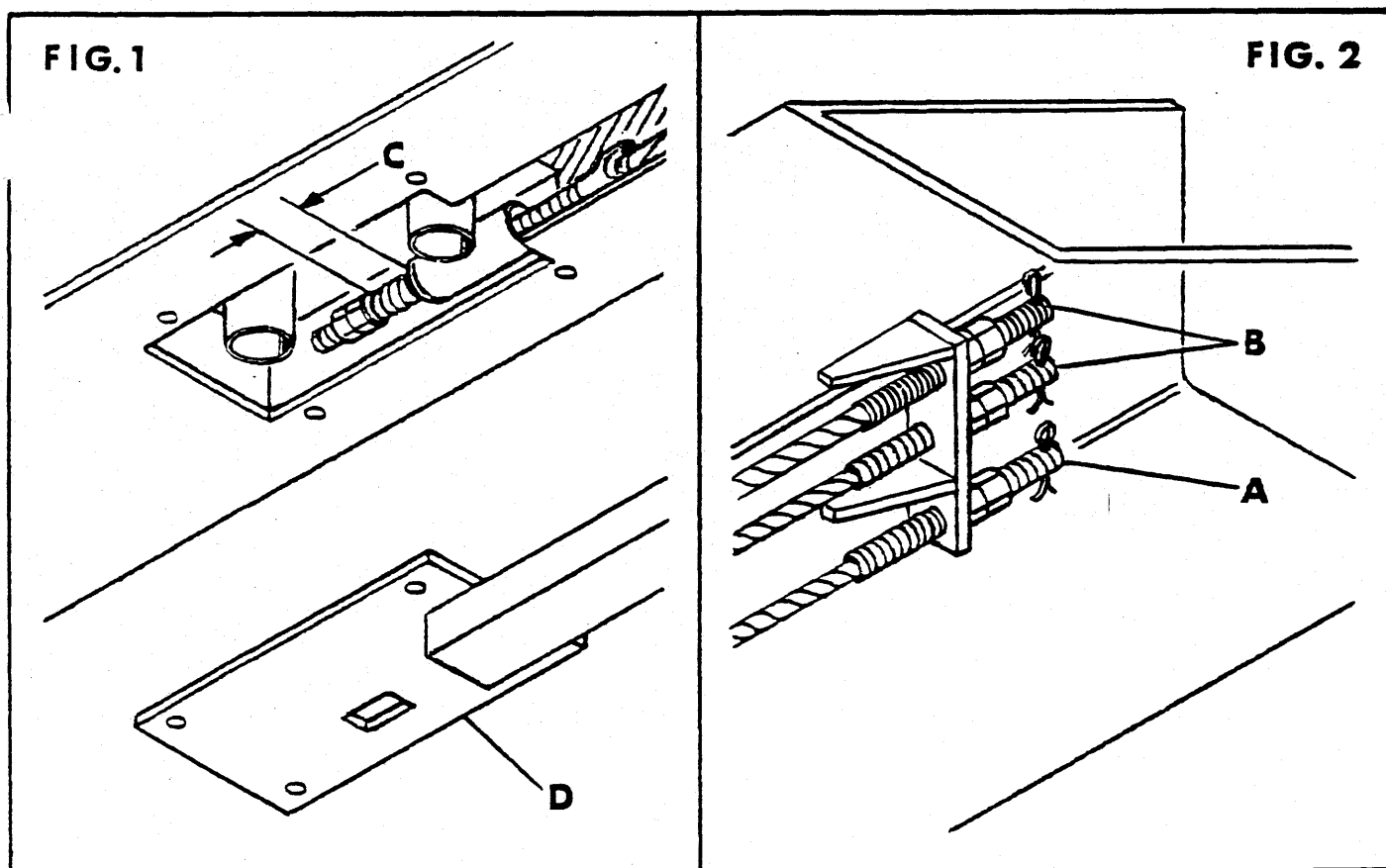
To properly torque and adjust mechanical cables, completely retract boom and remove cover on back of boom. Refer to Figure 2. Remove cotter pins from Cables A and B and loosen jam nut. Torque Cable A to 60 ft. lbs. Care must be taken to prevent cable from turning. Use wrench on flats of threaded end to hold cable from turning.

Torque cables shown in Figure 2, Item B, alternately to 30 ft. lbs. each.

After mechanical cables have been properly torqued, check adjustment. Figure 1, Item C, Spring, must measure 1-1/8 plus or minus 1/8. This measurement can be checked through the inspection hole located in Item D, Cover Plate.

Should it be necessary to adjust electrical cable, remove cover plate to make correction.

By extending and retracting boom a couple of times, re-check torque on mechanical cables and measurement on electrical cable. Adjust if necessary. Replace lock nut, cotter pins and cover plate.



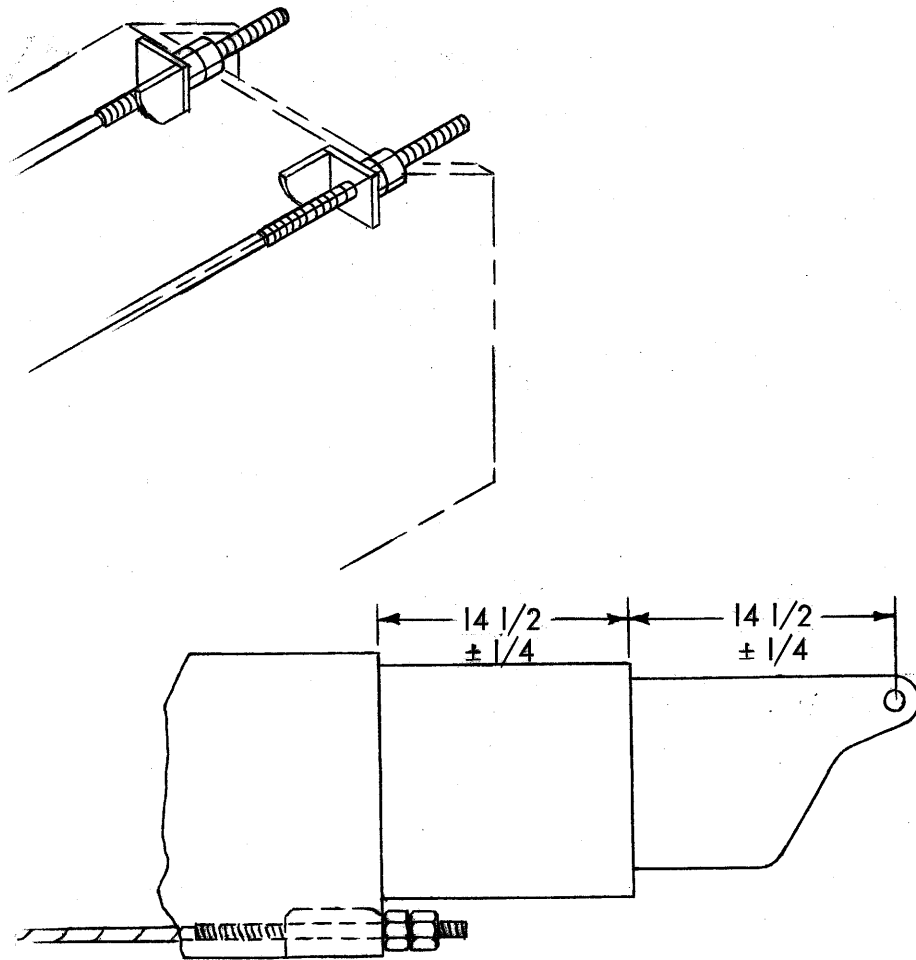
MECHANICAL AND ELECTRICAL CABLE ADJUSTMENT

(Applies to Models 58 and 68)

To properly torque and adjust wire rope cables, completely retract boom, check boom end measurement. See Figure 1, measurement should be $14\frac{1}{2}'' \pm \frac{1}{4}''$. Remove jam nuts from both extension and retraction cables. See Figure 11, Item A.

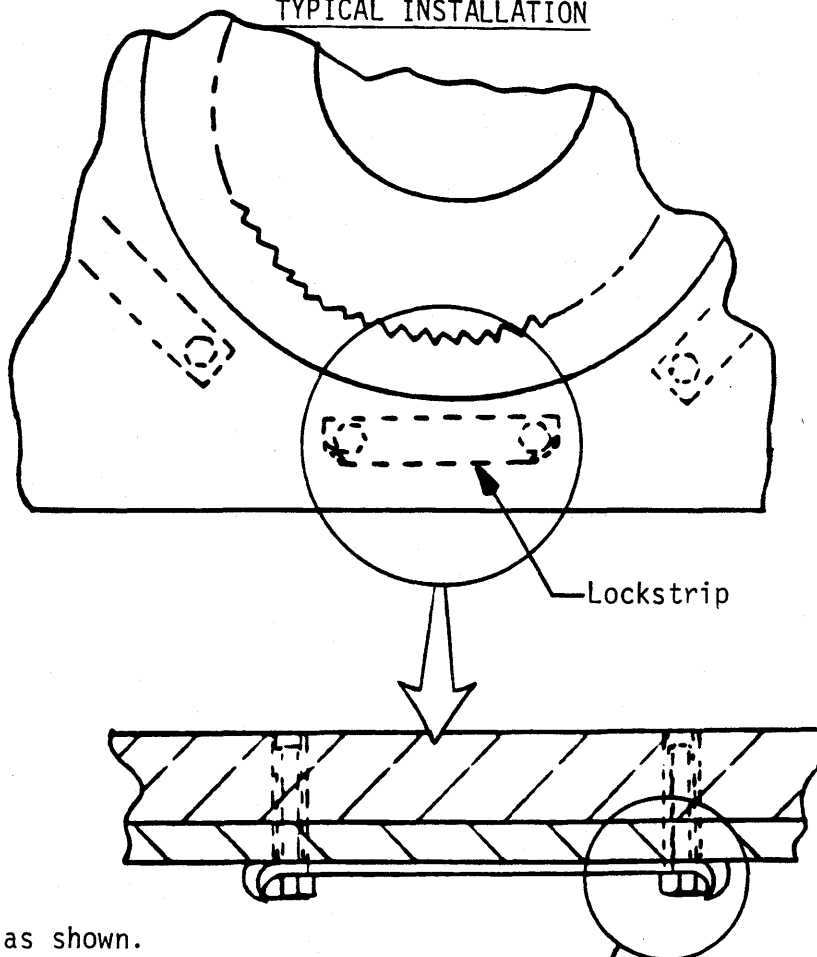
Initially torque all cables to 25 ft. lbs. Care must be taken to prevent cables from turning by using a wrench on the flats to hold cables. After all the cables are initially torqued to 25 ft. lbs., torque cables to 45 ft. lbs. in 5 ft. lbs. increments, alternating between extension and retraction cables.

When the cables have been torqued to 45 ft. lbs., extend and retract the boom a couple of times, recheck the torque and boom end measurement. (Figure 1.) Adjust if necessary. Finally, install and tighten jam nuts.

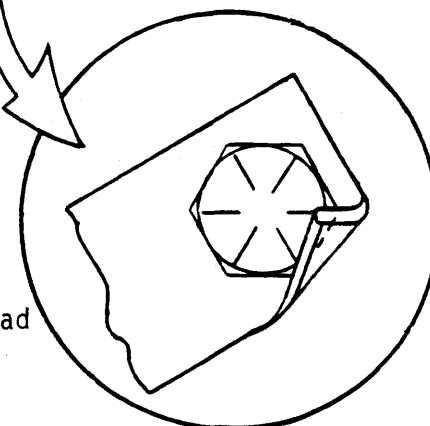




LOWER RING-GEAR BOLTS AND LOCKSTRIPS:
TYPICAL INSTALLATION



1. Install lockstrips as shown.
 - Use Kit #58004 for Condor Models 76, 68, 58, 56, 50, 6066, 5056, 4248.
 - Use Kit #58005 for Condor Models 60N, 46N, 36N, 4046N.
 - Use Kit #58006 for Condor Models 48, 4046, 3036N.
2. Bolts are special (grade, strength & length) for the Condor machines. DO NOT USE ANY OTHER BOLTS.
3. Do not use lockwashers.
4. Torque lower ring-gear bolts to $105 \text{ ft-}\#s \pm 5 \text{ ft-}\#s$, using conventional criss-cross torque sequence.
5. Bend-up ears (ends of lockstrips) on flat of bolt hex head as shown. Bend two places for each lockstrip.



Note: BE CERTAIN THE LOWER RING-GEAR BOLTS ARE CHECKED DURING THE NORMAL INSPECTION/SERVICING, AFTER EVERY 50-HOUR OPERATION OF YOUR CONDOR MACHINE(S).



LOWER RING GEAR-BOLTS & LOCKSTRIPS:

BILL OF MATERIAL

1. Kit #58004 for Condor Models 76, 68, 58, 56, 50, 6066, 5056, 4248, and 3238.

Consists of:

- Lockstrip
Calavar Part #68237; Qty = 9
- Special Hex Head Capscrews; 1/2-13 UNC x 1-3/4 long
Calavar Part #BOW36107; Qty = 18

2. Kit #58005 for Condor Models 60N, 46N, 36N, and 4046N.

Consists of:

- Lockstrip
Calavar Part #68226; Qty = 9
- Special Hex Head Capscrews; 1/2-13 UNC x 2-3/4 long
Calavar Part #BOW36111; Qty = 18

3. Kit #58006 for Condor Models 48, 4046, and 3036N.

Consists of:

- Lockstrip
Calavar Part #68226; Qty = 9
- Special Hex Head Capscrews; 1/2-13 UNC x 1-3/4 long
Calavar Part #BOW36107; Qty = 18

Note: Bolts are special (grade, strength and length) for the Condor machines. Use only Calavar supplied bolts in the above kits. DO NOT USE ANY OTHER BOLTS.

SELF-PROPELLED CONDOR

SPARE PARTS LIST

Stock will vary depending on units in inventory and type of use.

80305	Switch
80058	Switch
80026	Switch
80372	Switch
80306	Switch
	Limit Switch
80043	Key Switch
80023	Latching Relay
80024	Relay
E30JT	Stop, Start Switch
80025	Circuit Breaker
80378	Rheostat

WISCONSIN ENGINE PARTS

VJ-68	Rectifier Module
VJ-59	Regulator Module
KJ-16J	Champion Spark Plug
1GS-2224LB	Point Set
1BB-204255	Condensor

HONEYWELL PARTS

Controller

BERTEA PARTS

234912	Pilot Valve
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HYDRAULIC SPARE PARTS

S-29	Oil Filter (System Return)
C-68	Oil Filter (Control Pressure)
RU-40-S4	Oil Filter (Engine)

INTERVAL SYMBOL	LUBRICANT
○ SEMI-MONTHLY	CG - CHASSIS GREASE
△ MONTHLY	EO - ENGINE OIL
□ 4 MONTHS or 100 HOURS	GO - GEAR OIL
⬡ ANNUALLY	SL - SPRAY LUBE

TYPE OF LUBRICANT

CG-SHELL DARNA AX70330 or EQUIVALENT

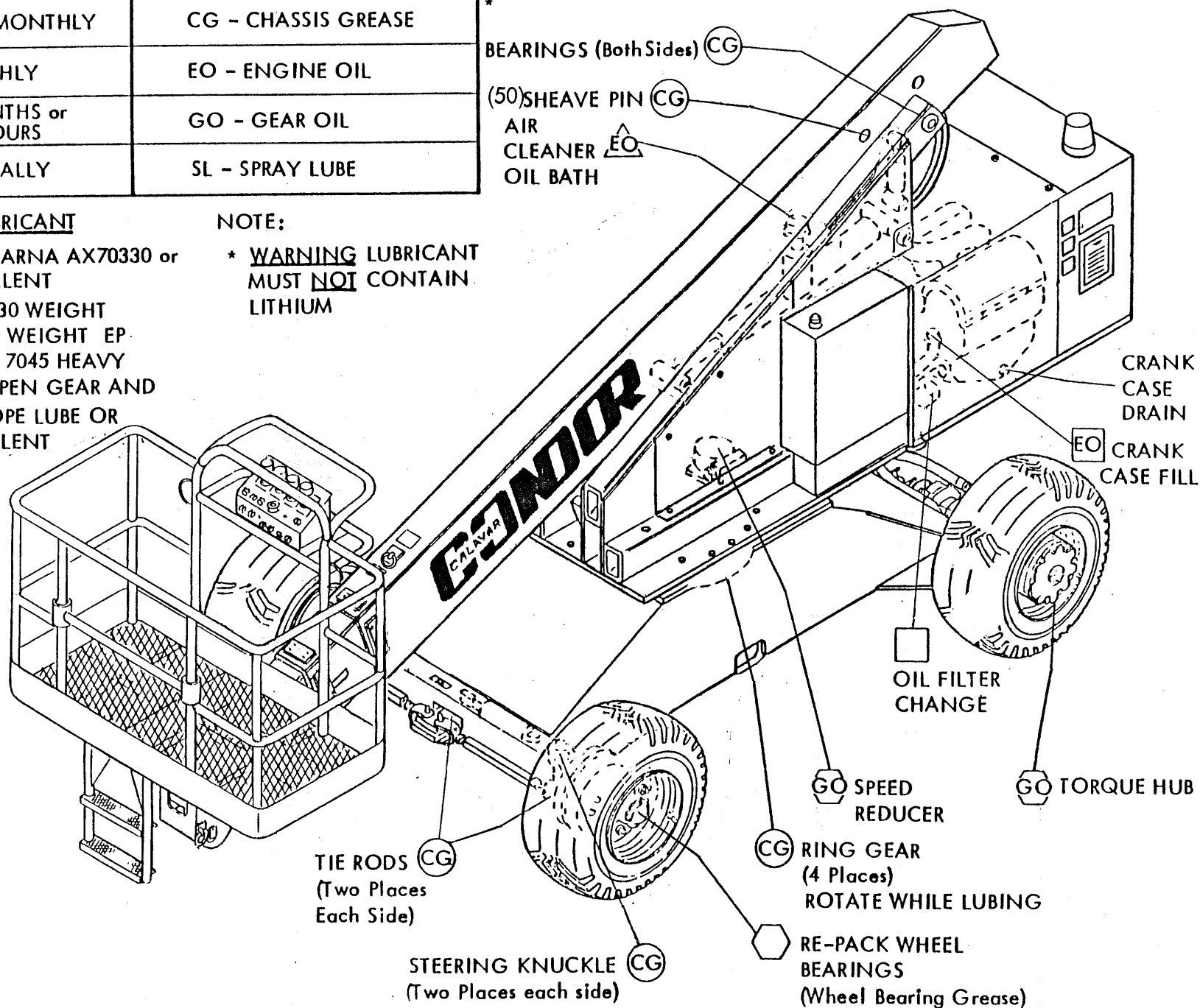
EO- S.A.E. 30 WEIGHT

GO - SAE 90 WEIGHT EP

SL- CROWN 7045 HEAVY DUTY OPEN GEAR AND WIRE ROPE LUBE OR EQUIVALENT

NOTE:

* **WARNING** LUBRICANT MUST **NOT** CONTAIN LITHIUM



INTERMEDIATE (50)
BOOM CABLE SHEAVE (CG) 58, 68 Side
(One place underneath) (Two Places)

PLATFORM LEVELING
SLAVE CYLINDER (CG)
(One Place)

MASTER LEVELING CYLINDER (CG)
(Two Places)

INTERMEDIATE BOOM
CABLE SHEAVES (50) (CG)
58, 68 Both Sides

TOPPING CYLINDER (CG)
(Two Places)

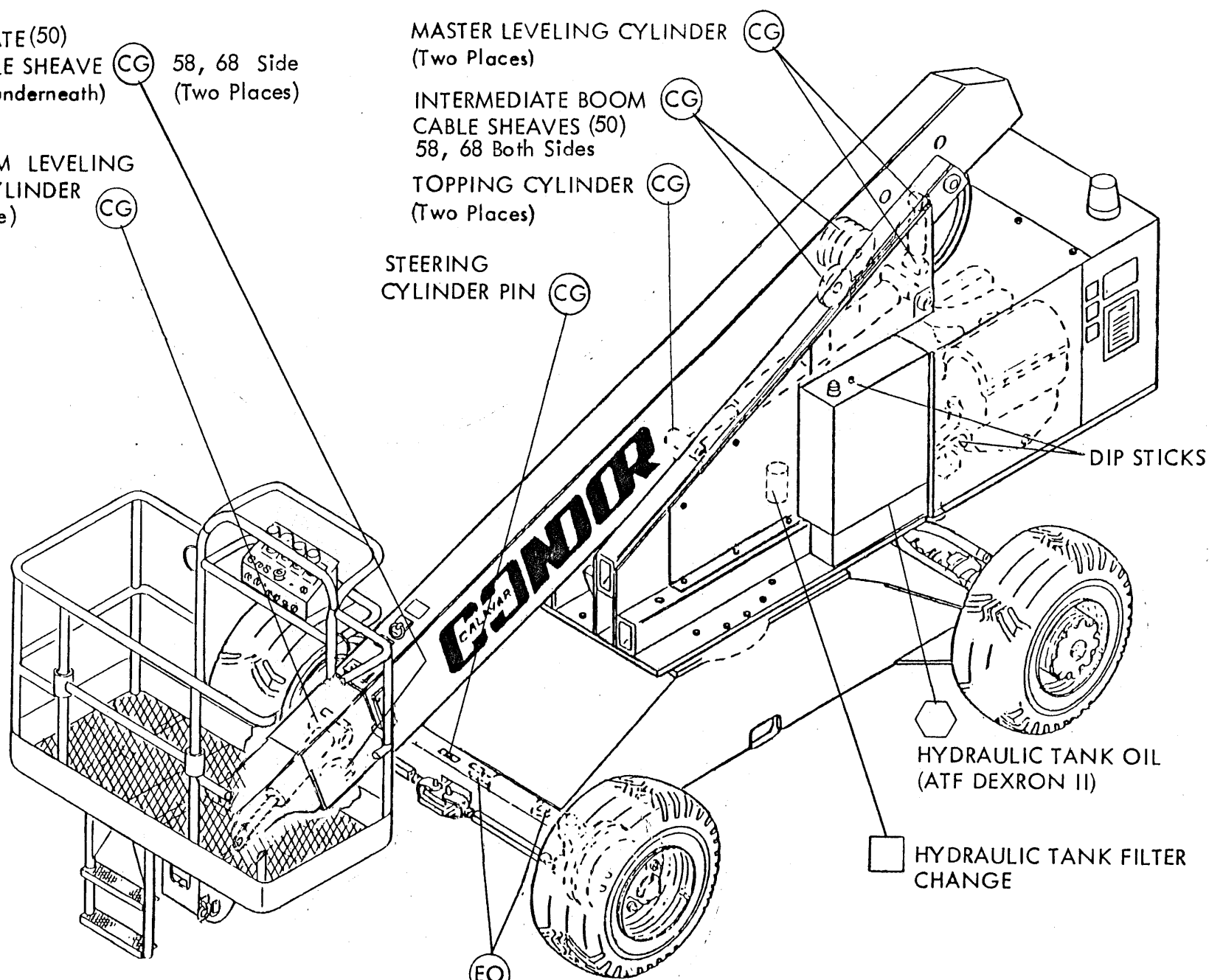
STEERING
CYLINDER PIN (CG)

DIP STICKS

HYDRAULIC TANK OIL
(ATF DEXRON II)

HYDRAULIC TANK FILTER
CHANGE

EO
STEERING CYLINDER
PIVOT POINTS
(Both Sides)



Lubrication

Type — EP 90

Oil Temperature

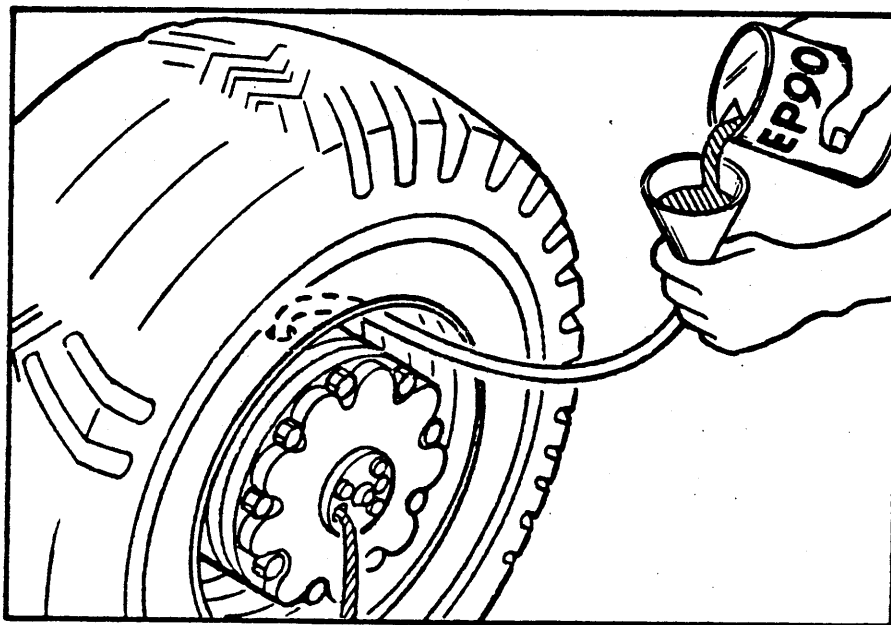
- Continuous — 160°F
- Intermittent — 200°F

Oil Change

- Initial — After 50 hours of operation
- Subsequent — 1000 hours or one year which ever comes first

Oil Fill Level

- Unit mounted horizontal — half-full



LUBRICATION

LUBRICATION

Refer to Self-Propelled Condor Lubrication Chart for location of items requiring lubrication and service. Recommended lubricating intervals are based on normal use in normal environmental conditions. User is cautioned to adjust the lubricating interval accordingly to meet each individual condition and usage.

Specific lubricants as recommended by the component manufacturers are generally the best choice. Should their lubricant not be available in your area, consult your local supplier for an equivalent. Under no circumstances should lubricant containing "LITHIUM" be used.

1. PRESSURE GUN LUBE POINTS

Lubricant

Chassis Grease

Shell Darna AX70330 or equal

Time Interval

50 Hours of Operation

Procedure

Service all fittings as indicated in chart. Clean lube fitting and apply pressure gun. Wipe away all excess lubricant from exposed surfaces. Over lubrication can collect dirt and foreign matter which acts as an abrasive.

When lubricating turret rotation bearing, it is recommended that turret be rotated.

2. AIR CLEANER (OIL BATH)

Lubricant

S.A.E. 30 weight engine oil

Time Interval

50 Hours of operation

Procedure

Remove oil cup from bottom of air cleaner and clean thoroughly. Fill to level line indicated on the oil cup.

3. STEERING CYLINDER PIVOT POINTS

Lubricant

S.A.E. 30 weight engine oil

Time Interval

50 Hours of operation

Procedure

Apply with oil can to both sides of pivot.

LUBRICATION (Continued)

4. ROTATION GEAR TEETH & PINION

Lubricant

Crown 7045 heavy duty open gear oil or equal.

Time Interval

500 Hours of operation, or yearly whichever comes first.

Procedure

Wipe clean gear teeth on rotation ring and pinion. Spray on lubricant.

5. ROTATION GEAR BOX

Lubricant

S.A.E. 90 weight EP oil

Time Interval

Check every 50 hours. Change every 500 hours of operation or yearly, whichever comes first.

Procedure

Remove drain plug on side. Refill until lever reaches about 1 in. from top of fill.

6. DRIVE TORQUE HUBS

Lubricant

S.A.E. 90 weight EP oil

Time Interval

Check periodically & fill as required. Change every 500 hours, or yearly, whichever comes first.

Procedure

To check level, rotate wheel so that level plug is horizontal. Remove plug if steady flow of oil runs out, unit is sufficiently full.

To add oil, remove fill plug on top of gear hub and level plug (horizontally). Fill until oil runs out of level plug.

7. WHEEL BEARINGS

Lubricant

Wheel-bearing grease

Time Interval

500 Hours or yearly, whichever comes first or upon reassembly

Procedure

Remove hub cap, clean out old lubricant and repack.

8. HYDRAULIC SYSTEM

A. Fluid Level

Check level daily. Maintain fluid level at full mark or dipstick with the boom fully retracted and in stowed position.

B. Hydraulic Oil Filter

Replace filter element every 100 hours of operation.

C. Procedure

Unscrew element and replace with new element.

8. HYDRAULIC SYSTEM (Continued)

C. Tank Breather

Clean every 50 hours of operation

Procedure

Remove from tank and clean with solvent, air blow dry

D. Hydraulic Tank

Procedure

Change every 500 hours or yearly, whichever comes first. Drain oil from tank and replace filter element. Add oil to tank required level.

Use only ATF Dexron II or equal. Do not mix hydraulic oil.

9. ENGINE

Refer to engine manufacturer's recommended maintenance and service procedure for lubricant and time interval.

HYDRAULIC
OIL SPECIFICATIONS

for

CALAVAR AERIAL WORK PLATFORMS

OIL COMPANY	CHEVRON	GULF	SHELL	UNION	MOBIL	CONOCO
BRAND NAME	ATF Dextron II D Series	ATF Dexron II	Donax	ATF Dexron	ATF 220	Dexron II
VISCOSITY, SUS @ 100° F SUS @ 210° F	205 50.1	195 50.4	175 49	200 52.3	187 50	170 50
VISCOSITY INDEX TYPICAL	150	155	160	172	159	145
FLASH POINT ° F	350°	405°	390°	395°	320°	365°
POUR POINT ° F	-45°	-50°	-45°	-45°	-50°	-45°

TROUBLESHOOTING GUIDE

In the following section are possible problems and their solutions. This section will save down time and provide a starting point for the mechanic to troubleshoot and isolate the cause for malfunction.

PART 1 - WISCONSIN ENGINE

1. ENGINE WILL NOT START (will not turn over)
 - A. Check battery and connection
 - B. Check starter solenoid
 - C. Check master switch
 - D. Check latching relay
 - E. Check starter
2. ENGINE WILL NOT RUN (engine turns over)
 - A. Check gas
 - B. Check ignition coil and points
 - C. Check fuel pump and fuel line
 - D. Check choke and air cleaner
 - E. Check fuel filter
3. ENGINE WILL NOT START - LP GAS
 - A. L.P. bottle opened too fast
 - B. Fuel line connection to bottle loose
 - C. Fuel flow to carburetor (lock off filter & vacuum switches)
 - D. Fuel storage tank empty
 - E. Regulator or carburetor
4. LOSS OF POWER (engine)
 - A. Timing
 - B. Governor setting (refer to Wisconsin Engine Manual)
 - C. Engine RPM too low
 - D. Wrong fuel (regular gasoline only)
5. UNIT WILL NOT START (electrical)
 - A. Battery dead
 - B. Battery connection
 - C. Solenoid bad
 - D. Check battery alternator

PART II - ELECTRICAL

1. BATTERY DEAD
 - A. Master switch left on with start circuit energized
 - B. Alternator inoperative (regulator or rectifier module)
 - C. Battery not to full charge
 - a. Dead battery
 - b. Condor battery used to jump start other equipment
2. FUNCTION INOPERATIVE FROM GROUND AND AERIAL
 - A. Check controller and toggle switch
 - B. Check wiring for continuity
 - C. Check pilot valves
 - D. Check for voltage into circuit
3. FUNCTION INOPERATIVE FROM EITHER GROUND OR AERIAL (Bertea)
 - A. Refer to Item 2 above
4. FUNCTION INOPERATIVE (Solenoid valve assembly)
 - A. Check coil on solenoid valve
 - B. Refer to Items 2 and 3
 - C. Check toggle switch
5. NO HYDRAULIC PRESSURE (Engine running, no high RPM)
 - A. Check circuit to pump solenoid
 - B. Check coil on pump solenoid (magnetic field if energized)
 - C. Open hydraulic tank gate valve
6. FUNCTION WILL CREEP WHEN NOT IN USE (Pump on stroke, high engine RPM)
 - A. Check controller for null
 - B. Check for voltage crossing over into another circuit
 - C. Air in end cap

PART III - HYDRAULIC

1. FUNCTION INOPERATIVE (Engine running high rpm, hydraulic pressure at 2100 or 2200 psi)
 - A. Check for control pressure
 - B. Check for plugged control pressure oil filter
 - C. Check in-line filter into main valve
2. NO CONTROL PRESSURE
 - A. Flow control valve (replace)

3. LOW OR NO HYDRAULIC PRESSURE

- A. Refer to Item 5 - Electrical
- B. Check compensator on John Deere Pump (set too low)
- C. Check oil tank gate valve

PART IV - DRIVE

1. LOSS OF DRIVE POWER

- A. Pump pressure set too low
- B. Driving unit in high gear
- C. Engine rpm too low
- D. Flow divider valve
- E. Posi-Traction Valve (open)
- F. Bad drive motor

2. UNIT WILL NOT MOVE FORWARD OR REVERSE

- A. Check torque hub (may be
- B. Refer to Item 2 - Electrical Section

3. UNIT WILL NOT SHIFT TO LOW OR HIGH (Model 68 only)

- A. Check limit switch (boom elevation and extension)
- B. Check two speed toggle switch and wiring
- C. Check hydraulic tow-speed solenoid valve (Hydraulic Panel, Figure 11, Item 123.)

4. NO STEERING

- A. Needle valve controlling oil flow to solenoid valve bank
- B. Check toggle switch and wiring
- C. Check coil on Racine Valve
- D. Damaged steering cylinder, or broken hydraulic line

NOTE: Above would apply to Platform Rotation and Tilt

5. BRAKES APPLY TOO FAST

- A. Alter brake adjustment valve (close slightly and reseal)
- B. "O" Ring on brake release piston damaged (W.S.I.)

6. BRAKES APPLY TOO SOON

- A. Alter brake adjustment valve (open slightly and reseal)

PART V - BOOM OPERATION

1. NO LIFTING POWER
 - A. Internal leak (cylinder)
 - B. Check system hydraulic pressure. Refer to specification page for applicable unit
2. BOOM BLEEDS DOWN
 - A. Check emergency bleed down valve (may be open)
 - B. Holding valve topping cylinder
 - C. Internal leak (cylinder)
3. BOOM RETRACTS (bleeds in or out)
 - A. Check holding valve
 - B. Internal leak (cylinder)
4. ELECTRICAL CABLE MOVING IN AND OUT WITH BOOM (at platform): MODEL 50 ONLY
 - A. Check electrical cable adjustment. NOTE: This adjustment can be seen on bottom of boom at turn-around bracket cover, and should be 1-1/8" from spring end to housing.
 - B. Boom mechanical cables loose (re-torque to 60 ft. lbs.)
5. EXCESSIVE BOOM PLAY
 - A. Missing or worn wear pads

PART VI - TURRET

1. EXCESSIVE TURRET ROTATION BACKLASH (turret rotation)
 - A. Check rotation gear box (loose)
 - B. Check brake in gear box (tighten)
 - C. Check ring gear bolts for torque (140 ft. lbs. turret, 80 ft. lbs. base)
2. BROKEN PIN RETAINERS BOTH TURRET AND BOOM
 - A. Lack of lubrication

PREVENTIVE MAINTENANCE

This section is devoted strictly to preventive maintenance. By using the Condor Installation Inspection Report as a guideline, the owner has a starting point from which a successful preventive maintenance program can begin.

Located under "Lubrication" in the Calavar Section of the Parts Manual is the Lubrication Chart showing the location of all the lube points. The specifications for lubrication and general inspection referred to in this section may have to be changed due to the application or environmental conditions the Condor is subjected to. For example: The air cleaner may have to be checked and serviced more frequently when the Condor is used in a sandblast operation than would normally be done if the unit was being used for assembly of fire sprinkler systems.

The following items should be checked and followed depending on the type of use to ensure the unit is in top mechanical condition.

A. GENERAL APPEARANCE

1. Clean unit (free of oil and dirt)
2. Operation and safety decals in place and legible
3. Tire pressure - see stencil on carriage
4. Tire condition (free of serious cuts or defects)
5. Proper engine oil level
6. Proper hydraulic oil level
7. Air cleaner oil level
8. Battery electrolyte level
9. Battery fully charged
10. Fuel level
11. Check and lube, if necessary (check lube chart for locations)
12. Check ring gear bolts for proper torque, 140 top, 80 bottom with Nordic lockwasher
13. Proper engine rpm
14. Proper brake operation
15. Hour meter reading

B. SEMI-MONTHLY

1. Check and lube, if necessary
2. Check battery electrolyte level

C. MONTHLY, OR FIRST 50 HOURS

1. Check and lube, if necessary
2. Check condition of battery
3. Check air cleaner
4. Change engine oil filter
5. Change hydraulic return oil filter
6. Check boom cables for torque
7. Check ring gear bolt for torque

D. SIX MONTHS, OR 100 HOURS

1. Check and lube, if necessary
2. Change control pressure oil filter
3. Change engine oil filter
4. Change hydraulic return oil filter
5. Check ring gear bolts for torque
6. Safety inspection (return form to Calavar)

E. ANNUALLY

1. Repack all wheel bearings
2. Check oil level---speed reducer, turret rotation
3. Change hydraulic oil (if unit has been used in sandblast operation regularly)
4. Check torque hub oil level
5. Check condition of boom cables
6. Safety inspection
7. Refer to lubrication chart

CONDOR OPERATION AND SAFETY MANUAL

It shall be the responsibility of all users to read and comply with the following common sense rules that are designed to promote safety and aid in better understanding the operation of the Self-Propelled Condor. These rules do not purport to be all inclusive, nor to supplant or replace other additional safety and precautionary measures to cover usual or unusual conditions. If these rules conflict in any way with any state, local or federal statute or regulations, said statute or regulation shall supersede these rules and it shall be the responsibility of each user to comply therewith.

UNLOADING:

1. If the use of loading ramp is necessary to unload the Condor, select a sturdy ramp. The Condor Model 50 weighs approximately 15,000 lbs. and the Condor Models 58, 68 weigh approximately 23,000 lbs.
2. If the work platform was removed for shipment, it must be replaced prior to unloading.

OPERATING:

1. Operating instructions are located on a placard on the ground control side of counterweight. Before operating unit, check out items as instructed on the placard and in this booklet.
2. Start unit and allow engine to warm up. If it is necessary to reposition boom, this can be done from the ground control station. Switch Aerial / Ground Selector Switch to Ground, and by activating toggle switches, the boom can be placed in a position that would be safe for unloading. If possible unload the Condor boom-first.
3. By switching Aerial/Ground Selector Switch to the Aerial Position, ground position controls are inoperative. Unit can now be operated from Aerial Position.
4. Aerial controllers are proportional, except for steering, platform tilt and platform rotation, which are bi-directional toggle switches. Each controller has a deadman lock-out mechanism that must be lifted before the controller can be activated. By lifting the deadman button not only is the controller free to be activated, but also will bring the pump from a stand-by position to a working position, while increasing engine rpm from idle to operating rpm.
5. Normal driving position for the Condor is with the counterweight over the driving wheels. Controller movement is based on this configuration. With counterweight over steering, the drive and steering control will react reversed.

6. Try each controller momentarily to orient yourself on its operation. The controller should always be moved gradually to obtain the smoothest possible operation.
7. Before unloading Condor, test the automatic braking system by moving forward and reverse to see that the brakes apply when the drive controller returns to the neutral position.
8. Located between the drive motors is the two speed valve. Handle up indicates high speed, minimum torque. Handle down indicates minimum speed, maximum torque. Unit should be loaded and unloaded in low---handle down.

INSPECTION:

1. Once unit has been unloaded, give the unit a visual inspection paying special attention to items listed below. This inspection should become part of a daily inspection performed at the beginning of a work shift by the assigned operator.

- A Check tire pressure
- B Check for cut or damaged tire
- C Check electrolyte level
- D Check engine oil
- E Check hydraulic oil level (use A.T.F. oil only)
- F Check oil cooler for damage and cleanliness
- G Check air cleaner oil level and cleanliness
- H Check stop and start circuit from ground and aerial position
- I Visual inspection for hydraulic leaks

NOTE: Condor models equipped with 54:1 torque hubs. Check operation of slope sensor device. If possible, place unit on slope of 5° or more, indicator light should come on and all boom functions will be inoperative.

The Condor Models are also equipped with limit switches. One located inside the boom and another located outside of boom at the boom to turret hinge pin. When either switch is activated, they automatically shift drive to low speed when boom is extended or raised to horizontal.

OPERATOR TRAINING:

1. In order for an operator to thoroughly understand the operation of a Condor and to become a qualified operator, it is recommended that after having been checked out by a trained, qualified operator, the trainee operator should move the unit to an area free of any overhead obstruction. The surface upon which the unit will be operated should be level with no hazardous irregularities or accumulation of debris.

2. Condors are equipped with automatic shift to low for the drive function. This is done automatically when boom is extended or reaches horizontal.
3. Elevate boom to approximately 60°, at this angle the operator will have a clear field of vision over the area below. Repeat low speed driving exercise.
4. With boom at 60°, extend boom approximately half way and repeat driving exercise.
5. With boom at 60° and half extension, rotate counterweight between drive wheels and repeat driving unit.
6. Extend boom to maximum and raise boom to 75°, rotate turret. Turret rotation is continuous. By gradually operating rotation controller giving full signal to rotation, and by gradually returning controller to neutral, the operator will learn how the rotation can be controlled to place unit along side a building smoothly.
7. Place counterweight over drive wheels, with unit at 75° and maximum extension. Repeat driving exercise.

NOTE: Extreme care must be taken when driving in this position, as ground vision has been reduced. The operator must watch for objects or personnel that may be in the area.

8. At the end of this exercise, the operator will have driven the Condor in both high speed and low speed; with extended and retracted boom; and will have driven the Condor with boom off to the side, and will have practiced placing Condor in imaginary work positions.

SAFETY:

Listed below are items pertaining to safety that the operator must know and follow.

1. The Calavar Self-Propelled Condor is a personnel lifting device and it is essential that it is properly maintained and operated to perform all functions with maximum safety and efficiency.
2. The operation of any new and unfamiliar equipment can be hazardous in the hands of untrained operators. Only trained operators should be assigned to operate the Condor.
3. It is the responsibility of the operator to be familiar with the manufacturer's manual and to follow all recommendations made. Never exceed manufacturer's recommended load.
4. It is the responsibility of the owner to instruct the operator with the safety requirements made not only by Calavar, but by various safety boards in your area, as well as requirements set down by OSHA and ANSI. (Note: See ANSI A92.5-1980.)

5. Do not operate Condor in excess of rated load specification.
6. The Condor is a non-insulated unit and must not be operated near high voltage lines.
7. Do not lean over platform railings to perform work.
8. Do not use ladder or makeshift devices on the platform to obtain greater heights.
9. Care must be taken to prevent raising or lowering boom into objects.
10. The platform capacity must be derated for all tools, accessories and operators.
11. Always distribute load evenly over work platform.
12. The Condor is equipped with Safety "D" Rings. A body belt must be worn with a safety strap attached.
13. Safety head gear should be worn by personnel in work platform.
14. Care must be taken in storing loose material in work platform such as pipe, rope, wire and miscellaneous boxes. If it is necessary to store such items in platform, they must be stored in such a way as to prevent walking or tripping over such items.
15. Do not alter equipment.
16. Do not override safety devices.
17. Slope control devices should be checked periodically for proper operation. Immediate repairs are mandatory on this device should it be found inoperative or disconnected.
18. Extremely uneven, sloping, or soft terrain is hazardous and must be avoided. The Condor must not be operated on terrain with more than a 5° slope.
19. The Condor boom is not to be used to push unit along ground.
20. The Condor boom is not to be used to lift wheels off ground.
21. Visual inspection of turret rotation ring gear bolts in turret and inside base assembly must be accomplished periodically and if found loose, re-torqued to 80 ft. lbs. on base bolts and 140 ft. lbs. on turret bolts.
22. Visually inspect tires. Tires that have been severely cut to the cord are dangerous and should be replaced. Recommended tire pressure must not be over inflated. (See Section One, Page 27.)

23. Visual inspection of inner boom extension/retraction cables must be accomplished periodically to determine any damage. Damaged cables must be replaced immediately. Failure to do so will result in a dangerous condition to both operator and equipment.
24. Under no circumstances should horseplay be tolerated. Report any foolishness or misuse of equipment to proper personnel.
25. Never take chances. Do not work on platform if your physical condition is such that you feel dizzy or unsteady in any way.
26. The Condor is not to be used ground for welding. Disconnect both positive and negative grouhd leads from battery before welding on Condor.



P R E V E N T A T I V E M A I N T E N A N C E

SELF-PROPELLED AERIAL WORK PLATFORMS

GENERAL

The finest equipment manufactured is only as good as it is maintained. Many times costly repairs and loss of revenue can be avoided by planning ahead, setting a regular schedule and performing preventative maintenance. You can do preventative maintenance NOW or costly repairs LATER.

This section is devoted to the PREVENTATIVE MAINTENANCE PROGRAM of the CONDOR and is broken down into two (2) phases; an INSPECTION maintenance and LUBRICATION maintenance. A lubrication chart and a complete preventative maintenance interval check list is provided.

The preventative INSPECTION maintenance is generally, but not limited to, the responsibility of the operator. It is to his best interest that the inspection maintenance be carried out as it directly effects his safety. The preventative LUBRICATION maintenance is the responsibility of the serviceman or mechanic as in some instances shop time will be required to perform the maintenance tasks.

Many of the suggestions for preventative maintenance described and noted herein may sound time consuming and expensive. This is not the case. The program has been carefully layed out and if closely followed, it will result in an extended life expectancy of the unit as well as the reduction in downtime and costly repairs.

The inspections and checks listed are not intended to replace any local or regional regulations which may pertain to this type of equipment, nor should the list and schedule be considered all inclusive. Variances in interval times may occur due to climate and/or conditions depending on the location and use of the machine.

Always insure that applicable safety precautions are strictly observed when performing the maintenance inspections and checks. Make certain that damaged components or those in need of adjustment, repair or replacement are corrected before operation.

PREVENTATIVE INSPECTION MAINTENANCE

This field inspection list provides for a systematic inspection of the CONDOR. The items listed to be inspected or checked daily will basically insure a good safe unit performance prior to start-up work operation. By accomplishing these inspections on a daily basis any potential malfunction will be identified and detected before it results in a major problem. The fifty (50) hour inspection will detect any defective, damaged or improperly secured part.

The 50-hour time interval is for normal operation. Should the unit be subjected to extensive use or if the application involves operation in abnormal environmental conditions, then the inspections should be made more often.

It is suggested that a maintenance log be kept and any conditions or items found to be abnormal should be recorded.

DAILY INSPECTION MAINTENANCE

A. VISUAL

- | | |
|---------------------------------------|--|
| 1. <u>Overall Condition</u> | Inspect platform, boom, turret and carriage that no physical damage is evident. Look for missing components, loose parts, etc. |
| 2. <u>Tire Condition</u> | Inspect tires for wear, cuts and proper pressure (<u>pneumatic filled only</u>) |
| 3. <u>Battery Cable Connections</u> | Inspect for looseness and corrosion of terminals. |
| 4. <u>Hydraulic Fluid Leaks</u> | Inspect that there is no evidence of fittings or hoses leaking. |
| 5. <u>Main Electrical Connections</u> | Inspect harness connections at rear of ground box and at platform console to assure they are tight. |

B. FLUID LEVEL CHECK

- | | |
|----------------------------|--|
| 1. <u>Engine Oil Level</u> | If low, add as recommended by engine manufacturer in quantity as required. |
|----------------------------|--|

B. FLUID LEVEL CHECK (Continued)

- | | |
|-------------------------------------|---|
| 2. <u>Engine Coolant Level</u> | Add as required (<u>water cooled engine only</u>) |
| 3. <u>Fuel Tank Level</u> | Check level |
| 4. <u>Hydraulic Tank Level</u> | If low, add ATF Dexron II as required. |
| 5. <u>Battery Electrolyte Level</u> | Add as required. |

C. OPERATIONAL TEST

NOTE: *Start engine and follow all instructions and procedures. Be observant of all instruments and controls for proper operation as well as each function of the unit. Pay particular attention to any unusual noises or jerky operation.*

1. Instrument Check

- | | |
|-----------------------|---|
| A. Hourmeter | Is it recording properly? |
| B. Ammeter | Is battery being charged? |
| C. Oil Pressure Gauge | (Diesel Engine) Is pressure indicating? |

2. Ground Control Console Operation Check

- | | |
|-----------------------|--|
| A. Toggle Switches | With engine off, check that all momentary switches return to neutral when actuated and released. |
| B. Boom Functions | Start engine and operate functions through one complete cycle. |
| C. Emergency Controls | Stop engine and operate emergency controls. |

3. Platform Control Console Operation Check

- | | |
|-----------------------|--|
| A. Toggle Switches | With engine off, check that all momentary switches return to neutral when actuated and released. |
| B. Controllers | Check that lever cannot be moved without pulling knob. Check that lever returns to center position when actuated & released. |
| C. Boom Functions | Start engine and operate all aerial functions one complete cycle. |
| D. Drive Functions | Operate drive and steering functions and check braking. |
| E. Emergency Controls | Stop engine and operate emergency controls. |
| F. Slope Sensor | For procedure, refer to vendor data in operation manual, Honeywell Section. |

PREVENTATIVE MAINTENANCE INSPECTION

EVERY FIFTY (50) HOURS OF OPERATION

A. CARRIAGE

- | | |
|------------------------------------|--|
| 1. <u>Visual Damage</u> | Inspect for weld cracks, dents, or bends. |
| 2. <u>Steering Cylinder</u> | Check cylinder and pins holding cylinder in place for proper installtion. |
| 3. <u>Steering Tie Rods</u> | Check pin installations and connections for loose, binding, worn or missing parts. |
| 4. <u>Steering Yokes</u> | Check installation, pins, caps, and steering stop. |
| 5. <u>Wheels</u> | Check for loose or missing lug nuts, loose or worn spindle, damaged or cracked rims. |
| 6. <u>Torque Hubs & Motors</u> | Check hub and motor connector and disc brake for leakage. |
| 7. <u>Hydraulic Fittings</u> | Check for leaks and tightness |
| 8. <u>Hydraulic Hoses</u> | Check for leaks, cuts, abrasions |
| 9. <u>Tire Pressure</u> | (Pneumatic filled) Check for proper pressure. |
| 10. <u>Tire Damage</u> | Check for wear & cuts |
| 11. <u>Rotation Gear</u> | Check bolts securing ring gear to chassis for tightness and that all lock tabs are in place. |

B. TURRET

- | | |
|----------------------------------|--|
| 1. <u>Visible Damage</u> | Inspect for weld cracks, dents or bends |
| 2. <u>Rotation Gear</u> | Check bolts securing gear to turret for tightness. |
| 3. <u>Rotation Gear Box</u> | Check oil level. Check mounting bolts. Inspect motor and coupling and pinion installation. |
| 4. <u>Rotary Coupling</u> | Inspect for leakage and check mounting bolts and bracket. |
| 5. <u>Hydraulic Valves</u> | Check mounting bolts and inspect for damage or leakage. |
| 6. <u>Hydraulic Hoses</u> | Check for leaks, cuts, abrasions |
| 7. <u>Hydraulic Fittings</u> | Check for leaks and tightness |
| 8. <u>Electrical Wiring</u> | Inspect for fraying cracked insulation |
| 9. <u>Electrical Connections</u> | Check for corrosion, looseness and insure good contact. |

B. TURRET (Continued)

- | | |
|-------------------------------------|---|
| 10. <u>Lift Cylinder</u> | Inspect for damage and leakage. Check pin installation and retainers. |
| 11. <u>Master Leveling Cylinder</u> | Inspect for damage and leakage. Check pin installation and retainers. |
| 12. <u>Counterweight</u> | Check mounting bolts for tightness. |
| 13. <u>Shrouding, Covers</u> | Check for loose, damaged or missing parts and fasteners. |

C. MAIN POWER SOURCE

- | | |
|---|---|
| 1. <u>Engine</u> | See engine manufacturer's "Operation & Maintenance Manual" for maintenance check list (Wisconsin, Deutz, Ford). |
| 2. <u>Air Cleaner</u> | Check oil level, mounting and connection. |
| 3. <u>Muffler</u> | Check shrouding, connection and mounting. |
| 4. <u>Exhaust Tube</u> | Check for rust, leaks and installation. |
| 5. <u>Engine Mounts</u> | Check bolts for tightness. |
| 6. <u>Throttle Solenoid and Linkage</u> | Check mounting, operation and connecting parts. |
| 7. <u>Fuel System</u> | Check tank, mounting, fuel line and connections. |
| 8. <u>Battery</u> | Check electrolyte level, mounting and hold down. |
| 9. <u>Battery Cables</u> | Check connections for tightness, corrosion and frayed insulation. |
| 10. <u>Hydraulic Pump</u> | Inspect pump for damage, check mounting bolts and connection to engine. |
| 11. <u>Emergency Motor/Pump</u> | Inspect pump and motor for damage. Check mounting bolts & electrical connection. |
| 12. <u>Hydraulic Hoses</u> | Check for leaks, cuts and abrasions. |
| 13. <u>Electrical Wiring</u> | Inspect for fraying, cracked insulation. |
| 14. <u>Electrical Connections</u> | Check for corrosion, looseness and insure good contact. |

D. BOOM ASSEMBLY

- | | |
|------------------------------|--|
| 1. <u>Visible Damage</u> | Inspect for weld cracks, dents or bends. |
| 2. <u>Pivot Pin</u> | Check pin installation and retainer. |
| 3. <u>Extension Cylinder</u> | Inspect for damage & leakage. Check pin installation & retainer. |

D. BOOM ASSEMBLY (Continued)

- | | |
|---|---|
| 4. <u>Hose & Cable Routing</u> | Check routing of hydraulic hose & electrical cable from turret to boom. Inspect for chafing, broken ties or overly tight routing. |
| 5. <u>Mechanical Cables</u>
(3-Section Boom) | Inspect cables for fraying or damage and tightness (torque). Inspect for proper installation on sheave. |
| 6. <u>Wear Pads</u> | Inspect for clearance, excessive wear. Check mounting bolts and adjustment. |
| 7. <u>Slave Leveling Cylinder</u> | Inspect for damage and leakage. Check pin installation and retainer. |
| 8. <u>Tie Down Ring</u> | Check for tightness. |
| 9. <u>Limit Switches</u> | Inspect for damage. Check electrical connection. |

E. PLATFORM AND SKIRT

- | | |
|---|--|
| 1. <u>Visible Damage</u> | Inspect for weld cracks, dents or bends. |
| 2. <u>Platform Mount</u> | Check platform to skirt mounting bolts for tightness. |
| 3. <u>Hydraulic Hose & Electrical Cable Routing</u> | Check routing from boom to skirt. Inspect for chafing broken ties or overly tight routing. |
| 4. <u>Platform Slide Bar</u> | Check that it slides freely. |

ON UNITS EQUIPPED WITH OPTIONAL 180° PLATFORM ROTATION--

- | | |
|---------------------------|---|
| 5. <u>Rotary Actuator</u> | Inspect for damage, leaks and mounting bolts for tightness. Check hydraulic hoses for cuts and abrasions. |
|---------------------------|---|

F. GROUND CONTROL CONSOLE

- | | |
|--|--|
| 1. <u>Visible Damage</u> | Inspect for weld cracks, dents or bends. |
| 2. <u>Mounting</u> | Check that bolts are secure. |
| 3. <u>External Electrical Connection</u> | Insure connection is firmly made. |
| 4. <u>Instruments</u> | Inspect for damage. |
| 5. <u>Internal Wiring</u> | Inspect for fraying broken insulation. Check that connections are tight. |
| 6. <u>Slope Sensor</u> | Inspect for damage and check mounting bolts for tightness. |
| 7. <u>Enclosure</u> | Check for any moisture, inspect cover seal. Insure cover is firmly secure. |

F. GROUND CONTROL PANEL (Continued)

- | | |
|---------------------------|---|
| 8. <u>Toggle Switches</u> | Check that momentary type return to center position when actuated and released. |
| 9. <u>Speed Control</u> | Insure knob is firmly secured to shaft.
Check that speed control rotates freely. |

G. PLATFORM CONTROL CONSOLE

- | | |
|--|---|
| 1. <u>Visible Damage</u> | Inspect for dents, etc. |
| 2. <u>Mounting</u> | Check that bolts are secure and tight. |
| 3. <u>External Electrical Connection</u> | Insure connections are firm. |
| 4. <u>Controllers</u> | A. Check mounting screws for tightness.
B. Check that handle cannot be moved without first lifting on knob.
C. Inspect rubber bellows for damage.
D. Check that handle returns to center when actuated and released. |
| 5. <u>Toggle Switches</u> | Check that momentary switches return to center position when actuated & released. |
| 6. <u>Engine Stop-Start</u> | Check that switch when actuated stays in "ON" or "OFF" position. |
| 7. <u>Electrical 110-V Receptacle</u> | Inspect for damage. |

H. OPERATIONAL SYSTEM

1. Operation with ground panel controls
 - A. Start engine and listen and/or observe:
 1. Unusual noise from engine or pump.
 2. Excessive engine vibration.
 3. Operation of hourmeter and ammeter.
 - B. Actuate boom "raise" control switch and observe:
 1. Increase in engine RPM (gasoline engines)
 2. Boom raises smoothly.
 3. Hydraulic hoses & electrical cable at rear of boom are properly moving.
 4. Proper platform leveling.
 5. At full travel release control, switch returns to center.
 6. Inspect lift cylinder rod for damage to chrome.
 7. Platform stays elevated, is not lowering under its own power.

H. OPERATIONAL SYSTEM (Continued)

8. With speed control in "slow" actuate boom "lower". Rotate speed control slowly to "fast" and observe change in speed.
- C. With boom horizontal, actuate boom "EXTEND" and observe:
 1. Any unusual noise in telescoping
 2. Boom telescopes smoothly
 3. At full extension, release control, switch returns to center.
 4. Visually inspect inner boom sections for weld cracks, dents or scouring.
- D. Actuate boom rotate control and observe:
 1. Any unusual noise during rotation
 2. Release control, switch returns to center
- E. Actuate emergency power switch (engine OFF) and any of the boom function controls, observe:
 1. Any unusual noise
 2. Function operates normally
2. Place speed selector switch in "FAST". Actuate drive controller and observe:
 - A. Travel starts smoothly and stops smoothly when control is released.
 - B. Travel speed is in high range.
3. With speed selector in "FAST" actuate boom extension and drive controller travel speed should automatically switch to slow range. Retract boom.
4. With speed selector in "FAST" actuate boom "Raise" until above horizontal and actuate drive controller. Travel speed should automatically switch to slow range.
5. Actuate steering control right and left, observe:
 - A. Steering wheels turn smoothly
 - B. Steering continues until stops are reached.



PREVENTATIVE MAINTENANCE INTERVAL CHECK LIST

--Operational Hours Or Yearly, Whichever Comes First--

ITEM REQUIRING ATTENTION	DAILY	50 HOURS	100 HOURS	500 HOURS	1,000 HOURS	YEARLY
A) <u>Carriage Assembly</u>						
1 - Visible Damage--Weld Cracks, Dents		X				
2 - Steering Cylinder and Pins		X				
3 - Steering Tie Rods and Connections		X				
4 - Steering Yokes		X				
5 - Lubricate Steering Points		X				
6 - Repack Wheel Bearings				X		X
7 - Visually Inspect Torque Hubs, Motors		X				
8 - Check Torque Hub Oil Level		X				
9 - Change Torque Hub Oil				X		X
10- Inspect Wheel Mtg., Lugs, Rims		X				
11- Inspect Tires for Cuts and Damages	X					
12- Check Tire Pressure (Pneumatic)		X				
13- Check Hydraulic Fittings and Hoses		X				
14- Check Rotation Gear Bolts		X				
B) <u>Turret Assembly</u>						
1 - Visible Damage--Weld Cracks, Dents		X				
2 - Check Rotation Gear Bolts		X				
3 - Check Rotary Coupling Mounting Bolts		X				
4 - Check Rotation Gear Box Mounting		X				
5 - Check Rotation Gear Box Oil Level		X				
6 - Change Rotation Gear Box Oil				X		X
7 - Check Rotation Drive Motor and Pinion		X				
8 - Check Hydraulic Valve Mounting		X				
9 - Check Hydraulic Hoses and Fittings		X				
10- Check Wiring and Electrical Connections		X				
11- Inspect Lift Cylinder		X				
12- Inspect Lift Cylinder Pins		X				
13- Inspect Master Level Cylinder		X				
14- Lubricate Lift and Level Cylinder Pins			X			
15- Check Counterweight Mounting Bolts		X				
16- Inspect Shrouding, Covers		X				

PREVENTATIVE MAINTENANCE CHECK LIST

ITEM REQUIRING ATTENTION	DAILY	50 HOURS	100 HOURS	500 HOURS	1,000 HOURS	YEARLY
C) <u>Main Power Source</u>						
1 - Engine (Refer to Engine Manufacturer's Manual)						
2 - Inspect Air Cleaner Connection		X				
3 - Change Air Cleaner Oil		X				
4 - Check Exhaust Tubing Connections		X				
5 - Inspect Muffler, Shrouding, Mounting		X				
6 - Check Engine Mounting		X				
7 - Check Throttle Solenoid and Linkage		X				
8 - Check Fuel Tank Level	X					
9 - Check Fuel Tank Mounting Bolts		X				
10- Check Fuel Line Connections		X				
11- Check Battery Electrolyte Level	X					
12- Check Battery Mounting and Hold Down		X				
13- Check Battery Cable and Connection		X				
14- Check Hydraulic Pump Mounting		X				
15- Check Emergency Pump/Motor Mounting		X				
16- Inspect Hydraulic Fittings and Hoses		X				
17- Check Wiring and Electrical Connections		X				
D) <u>Boom Assembly</u>						
1 - Visible Damage--Weld Cracks, Dents		X				
2 - Inspect Installation Boom Pivot Pin		X				
3 - Inspect Installation Master Level Pin		X				
4 - Inspect Installation Ext. Cylinder Pin		X				
5 - Lubricate Pins		X				
6 - Inspect Extension-Retracton Cables (3 Section Boom)		X				
7 - Check Cables for Torque (3 Section Boom)			X			
8 - Check Boom Wear Pads Mounting Bolts		X				
9 - Check Boom Wear Pads Clearance, Wear		X				
10- Inspect Installation Boom to Skirt Pin		X				
11- Inspect Installation Slave Cylinder Pin		X				
12- Inspect Slave Cylinder		X				

PREVENTATIVE MAINTENANCE CHECK LIST

ITEM REQUIRING ATTENTION	DAILY	50 HOURS	100 HOURS	500 HOURS	1,000 HOURS	YEARLY
D) <u>Boom Assembly (continued)</u>						
13- Lubricate Slave Cylinder and Skirt Pins		X				
14- Inspect Hydraulic Hose and Electrical Cable Routing		X				
15- Check Boom Tie Down Ring		X				
16- Inspect Interlock Limit Switches		X				
E) <u>Platform and Skirt</u>						
1 - Visible Damage--Weld Cracks, Dents		X				
2 - Check Platform to Skirt Mounting Bolts		X				
<u>For Units With 180° Platform Rotation</u>						
1 - Inspect Rotary Actuator for Damage		X				
2 - Check Mounting Bolts		X				
3 - Check Hydraulic Fittings and Hoses		X				
F) <u>Ground Control Box</u>						
1 - Check Mounting of Enclosure		X				
2 - Check External Electrical Connection		X				
3 - Check Hour Meter and Ammeter for Damage		X				
4 - Check Internal Wiring and Connections		X				
5 - Check Seal on Enclosure Cover		X				
6 - Check Slope Sensor Mounting Bolts		X				
7 - Check Toggle Switch's Return to Center	X					
8 - Check Speed Control Knob is Secure		X				
9 - Check Speed Control Operates Freely	X					
G) <u>Platform Control Console</u>						
1 - Check Console is Securely Mounted		X				
2 - Check External Electrical Connections		X				
3 - Inspect Console for Damage	X					
4 - Check Controller Mounting Screws		X				
5 - Inspect Controller Rubber Bellows		X				
6 - Check Control Does Not Move Without Raising Knob	X					

PREVENTATIVE MAINTENANCE CHECK LIST

ITEM REQUIRING ATTENTION	DAILY	50 HOURS	100 HOURS	500 HOURS	1,000 HOURS	YEARLY
G) <u>Platform Control Console</u> (continued)						
7 - Check Control Lever Returns to Center	X					
8 - Check Toggle Switches Return to Center	X					
9 - Engine "Stop-Start" Retains Position	X					
10- Inspect 110 Volt Outlet for Damage		X				
H) <u>Hydraulic System</u>						
1 - Check Hydraulic Tank Fluid Level	X					
2 - Clean Hydraulic Tank Breather		X				
3 - Change Hydraulic Filter			X			
4 - Change Hydraulic Fluid in Tank				X		X
5 - Check Hydraulic Fittings and Hoses		X				

GENERAL SPECIFICATIONS AND INFORMATION

1. ENGINE

- A. Wisconsin VG4D, 37 hp (Calavar P/N 40017)
- B. Operating speed 2100 rpm
- C. Idle speed, 1250 rpm
- D. Battery, 12 volt, 83 amp. hr.
- E. External alternator, 37 amp. at 2100 rpm engine speed

2. PUMP

- A. John Deere, PR-24
- B. For pressures and flow, see Table 1

3. MAIN VALVE

- A. Berteau
- B. System relief, 2750 psi
- C. Control relief, 300 psi
- D. Control pressure, 350 to 370 psi
- E. Operating voltage, 4.2 volts, 60 milliamperes (max.)

4. SOLENOID VALVE

- A. Racine valve
- B. Operative voltage - 12 volt
- C. Operating flow, 3 gpm

5. HOLDING VALVES (set and sealed at factory)

- A. Platform leveling holding valve, 2900 psi
- B. Boom lift holding valve, 2900 psi
- C. Boom extension relief valve, 1200 psi

6. BOOM MECHANICAL CABLES

- A. Torque bottom (retraction) cable first at 60 ft. lbs., then torque top (extension) cable to 60 ft. lbs.

7. ELECTRICAL CABLE ADJUSTMENT

- A. 1-1/8 plus or minus 1/8 from end of spring to spring housing (Model 50)

8. TIRE PRESSURE

- A. 65 psi - Model 48
70 psi - Models 40, 50, 56
75 psi - Models 58, 68

9. RING GEAR BOLTS

- A. Base to ring gear, 80 ft. lbs. (Bowmalock bolts)
- B. Turret to ring gear, 140 ft. lbs. (Special bolts and nuts)

10. WEIGHT (approximate only)

- A. Model 40.....15,000 lbs.
- B. Model 48.....12,000 lbs.
- C. Model 50 and 56.....15,000 lbs.
- D. Model 58.....23,000 lbs.
- E. Model 68 and 76.....23,000 lbs.

11. FUNCTION TIME TABLE, plus or minus 10%

FUNCTION	Model 48	Models 40,50,56	Model 58	Model 68
Boom Extension	40 sec.	24 sec.	25 sec.	47 sec.
Boom Retraction	31 sec.	21 sec.	25 sec.	44 sec.
Topping - Up	38 sec.	49 sec.	55 sec.	58 sec.
Topping - Down	28 sec.	35 sec.	43 sec.	41 sec.
Turret Rotation-CW	117 sec.	104 sec.	112 sec.	110 sec.
Turret Rotation-CCW	114 sec.	110 sec.	115 sec.	105 sec.
100 ft. drive forward - high	37 sec.	52 sec.	78 sec.	74 sec.
100 ft. drive reverse - high	38 sec.	53 sec.	81 sec.	75 sec.

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.



CONDOR® SERVICE INFORMATION

1. If you need assistance or have any service or maintenance questions, TIME CONDOR Corporation service and parts personnel are always available by phone or fax. The telephone numbers are:

(254) 420-5200 Telephone
(254) 420-5298 Voice Mail
(800) 443-5803 FAX

2. There are numerous written Maintenance Procedures available for this machine. These procedures are available through the TIME CONDOR Corporation Service Department to anyone who requests them.
3. Service and maintenance are not a substitute for trained, qualified service technicians. TIME CONDOR Corporation conducts service schools on a continuing basis. Call any of our service or sales persons for a schedule. Remember, training of mechanics is the responsibility of their employer, but TIME CONDOR Corporation Service Schools help you provide this training.
4. TIME CONDOR Corporation Service School Training Manuals are available for purchase through the parts department. The part numbers for these manuals are: #92333 for self-propelled models; and #92334 for truck-mounted models.

TIME CONDOR Corporation



CALAVAR CORPORATION



Self – Propelled Booms and Scissors WARRANTY

Calavar Corporation ("Calavar") warrants to the purchaser that each new aerial work platform made by Calavar is free from defects in material and workmanship arising under normal use and service, in the case of major weldments (chassis, turret and booms), for a period of **5** years after the original shipment of the aerial work platform from Calavar's plant; and in the case of all other parts, for a period of **1** year after the aerial work platform is first placed in service or **two** years after the original shipment of the aerial work platform from Calavar's plant, whichever occurs first.

The obligation and liability under this Warranty is expressly limited to repairing or, at Calavar's option, replacing free of charge, at its factory in Waco, Texas or at an authorized repair facility designated by Calavar, the defective part. In no event shall Calavar or its suppliers be liable to the purchaser or any other person for transportation charges or for any incidental, collateral, special or consequential damages, including without limitation damages for loss of profits, loss of customers, loss of goodwill or work stoppage, claims by any party other than the purchaser, or any other similar damages or loss even if Calavar, its suppliers or its representatives have been advised of the possibility of such damages.

Parts claimed to be defective and for which repair or replacement is desired shall be returned transportation **prepaid** to Calavar's factory for inspection. This Warranty applies to replacement parts provided under the terms of this Warranty only for the remainder of the Warranty period applicable to the original purchase.

Any operation of the equipment beyond rated capacity, improper use or application of the equipment, substitution upon it of parts not approved by Calavar or alteration or repair of the equipment by any person not authorized by Calavar shall, at Calavar's option, void this Warranty. Calavar shall have no liability or responsibility for damages resulting from accident or the malfunction of equipment and components not supplied by Calavar.

No agent, employee, distributor, dealer or other representative of Calavar is authorized to modify this Warranty in any way. Accordingly, additional statements or presentations by any such representative, whether oral or written, do not constitute warranties by Calavar and should not be relied upon as limited warranties of Calavar, and no attempt, effort or promise to repair equipment by Calavar or any such representative at any time shall modify or extend this Warranty in any way. If the purchaser has used its own order form, no additional or different warranty terms contained in purchaser's form will be honored by Calavar. This Warranty covers only new and unused aerial work platforms manufactured by Calavar. Products or parts manufactured by others are covered only by such warranties as are extended to the purchaser by Calavar's suppliers.

This Warranty is in lieu of all other warranties, expressed or implied, including but not limited to warranties of merchantability and fitness for a particular purpose. Any applicable implied warranty shall be limited in duration to the warranty period.

8300 Imperial Drive, P.O. Box 21447, Waco, Texas 76702-1447 • 817-666-4545, 817-666-4544 FAX

Effective January 1, 1993

WARRANTY PROGRAM

Warranty is a function of a manufacturing company to back up the product it manufactures. It is a guarantee against defects in design and workmanship of components utilized in the product, and is offered for a fixed period of time following the purchase of the product by a customer.

Calavar Warranty states, in general, that Calavar will replace free of charge any components found to be defective within the time frame of the warranty period. There are exceptions to some components which are not the responsibility of Calavar. These will be outlined in subsequent paragraphs.

A. WARRANTY PERIOD

1. The Self-Propelled Boom and Scissor Warranty is one (1) year from placing the **CONDOR®** in service or two (2) years following shipment from Calavar, whichever comes first. In the case of major weldments (chassis, turret, and booms), the Warranty Period is five (5) years following shipment from Calavar.
2. The Truck-Mounted **CONDOR®** Warranty Period is one (1) year from shipment of the **CONDOR®** from Calavar's plant.
3. For parts sold through the Parts Department, the Warranty Period is six (6) months from utilizing the component or placing it in service, or twelve (12) months following shipment from Calavar, whichever comes first, unless the part is furnished to correct a defective part on the original shipment still under Warranty.
4. Replacement parts provided under the terms of the Warranty are for the Warranty Period applicable to the unit in which they were installed as if such parts were original components of the aerial work platform.
5. During the Warranty Period, in addition to covering the parts replaced under Warranty, Calavar will pay a Dealer Warranty Labor Rate which is based on a percentage of your standard shop labor rate.

NOTE:

The term "IN SERVICE" means that the Warranty starts at the time the **CONDOR®** is first used for any purpose. An example: The dealer may have purchased a **CONDOR®** to have in stock, but may not use it. After three months, the **CONDOR®** is sold or the dealer decides to put the **CONDOR®** into its rental fleet. In this situation, the Warranty Period begins the day the dealer puts the **CONDOR®** into the fleet or when the **CONDOR®** is delivered to the end user.

The submittal of a warranty claim against a stock machine constitutes it as being "in service," initiating the warranty period.

B. PRE-DELIVERY INSPECTION SHEET (P.D.I.)

1. Each Self-Propelled Boom or Scissor **CONDOR®** shipped from Calavar's facility will have a Pre-Delivery Inspection (P.D.I.) sheet enclosed in the Safety Manual holder tube.
2. It will be the responsibility of the original recipient of the **CONDOR®** from Calavar, whether it will be the dealer or the end user, to complete this form and return it to Calavar's facility within 45 days from the date of receipt to set up the Warranty Account.
3. Failure to complete the P.D.I. sheet and return it to Calavar within the time frame given will result in voiding the Warranty on the **CONDOR®**.

NOTE:

The form must be filled out completely, giving the name of the dealer, address, model number, serial number, person inspecting the **CONDOR®** 's, signature, and date of inspection. (The date of inspection does not constitute the "In Service" date.)

C. ITEMS NOT COVERED UNDER WARRANTY

Some components are used on the **CONDOR®** which are not warranted by Calavar. However, these are warranted by the component manufacturer. Some of these are:

1. **Engine:** Manufacturers used include Wisconsin, Ford, Deutz, Isuzu, Kubota, Onan, Cummins, John Deere, and others. To apply for warranty on the engine, contact should be made with the engine manufacturer's dealer in your area. Calavar can advise you who the dealer is if unknown to you.
2. **Tires and Batteries:** These are normal wear items and are considered normal maintenance items. However, if they are found to be defective, contact can be made with the manufacturer's local dealer.
3. **Hydraulic Filters and Fluid:** These are considered general maintenance and service items, and are not covered by warranty.
4. **Other components:** Products or parts manufactured by others are covered only by such warranties as are extended to Calavar by its suppliers.
5. **Freight and Charges:** The warranty does not include any transportation, other charges, or the cost of installation or any liability for direct, indirect, or consequential damages or delay resulting from the defect.
6. **Travel Time / Mileage:** Travel time and the mileage to and from dealer facilities to **CONDOR®** location are not covered or reimbursable.
7. **Troubleshooting:** Troubleshooting is not covered or reimbursable. However, Calavar Warranty will cover reasonable labor charges for the removal and replacement of defective components.

D. PROCESSING OF WARRANTY CLAIM

During the Warranty Period, should a component failure be encountered within the guidelines of the Calavar Warranty Policy, the following procedure is to be followed:

1. Upon identifying the defective component, the replacement can be obtained by:
 - a. Issuing an order to our Parts Department through normal channels, which entails your being invoiced.
 - b. You may have previously purchased the part from Calavar for your stock and will utilize it for this replacement.

The above two methods will enable you to indicate on the claim the Calavar invoice number to substantiate the parts purchase and the amount to be credited.

- c. Although not recommended, you may purchase the part locally. When this is done, a copy of the purchase order or receipt **MUST** accompany the claim. Calavar has the option to ship a replacement part at no charge if the local cost would be greater, in lieu of issuing credit for locally purchased parts.
 - d. When parts are purchased from Calavar, part numbers with invoice numbers **MUST** be referenced in the appropriate section of the claim form.
2. Complete the Warranty Claim as noted in the "Warranty Claim Procedure" section. Provide as much information as possible to enable Calavar to thoroughly evaluate the claim and process it in the shortest amount of time possible.

NOTE:

WARRANTY CLAIMS NOT RECEIVED BY CALAVAR WITHIN 45 DAYS OF FAILURE WILL BE DENIED

- -
 3. Provided no return parts are required and all the information has been verified, the claim will be processed and credit will be issued against your account.

E. RETURN AUTHORIZATION

1. If a component is found to be defective within the normal guidelines of the Warranty, a Warranty Claim Form must be completed.
2. It will be necessary for you to call the Calavar Service Department and ask to be issued a Return Authorization (R/A) number. You will be asked for a Dealer Claim Number. As noted in Section 2, Item A, of the Warranty Claim Procedure, this is a number assigned by the dealer for the purpose of tracking the claim, as there may be more than one claim for the same **CONDOR®**. The R/A number issued must be logged in the appropriate section of the claim form, and the gold copy (R/A) of the form must be returned with the parts being returned.

NOTE:

**DO NOT SHIP ANY RETURN PARTS WITHOUT
A RETURN AUTHORIZATION (R/A) NUMBER**

Doing so may result in parts getting lost in the system and may delay processing the claim, or may cause denial due to the time element of the claim.

3. All R/A parts must be received at Calavar within 45 days from the date the R/A number was issued. Failure to do so will cause the claim to be denied.
4. All parts claimed under Warranty will be required to be shipped back to Calavar **FREIGHT PREPAID**. No freight collect shipments will be accepted.

APPENDIX A



TIME CONDOR Corporation

BOLT TORQUE CHART

NOMINAL THREADS	BASIC MAJOR DIA INCH	STRESS AREA SQ. IN	TENSILE STRENGTH (T) MIN				SAE GRADE 5			SAE GRADE 8		
			PROOF LOAD (P)				SAE GRADE 5			SAE GRADE 8		
			SAE GRADE (1957)				SAE GRADE 5			SAE GRADE 8		
			GRADE 5		GRADE 8		CLAMP LOAD LBS.	ASSEMBLY TORQUE		CLAMP LOAD LBS.	ASSEMBLY TORQUE	
			T	P	T	P		R=.200 DRY	R=.150 LUB		R=.200 DRY	R=.150 LUB
4-40	.1120	.00604	120KSI	85KSI	150KSI	120KSI	380	8LB-IN	6LB-IN	540	12LB-IN	9LB-IN
4-48	.1120	.00661	120KSI	85KSI	150KSI	120KSI	420	9LB-IN	7LB-IN	600	13LB-IN	10LB-IN
6-32	.1380	.00909	120KSI	85KSI	150KSI	120KSI	580	16LB-IN	12LB-IN	820	23LB-IN	17LB-IN
6-40	.1380	.01015	120KSI	85KSI	150KSI	120KSI	640	18LB-IN	13LB-IN	920	25LB-IN	19LB-IN
8-32	.1640	.01400	120KSI	85KSI	150KSI	120KSI	900	30LB-IN	22LB-IN	1260	41LB-IN	31LB-IN
8-36	.1640	.01474	120KSI	85KSI	150KSI	120KSI	940	31LB-IN	23LB-IN	1320	43LB-IN	32LB-IN
10-24	.1900	.01750	120KSI	85KSI	150KSI	120KSI	1120	43LB-IN	32LB-IN	1580	60LB-IN	45LB-IN
10-32	.1900	.0200	120KSI	85KSI	150KSI	120KSI	1285	49LB-IN	36LB-IN	1800	68LB-IN	51LB-IN
1/4-20	.2500	.03180	120KSI	85KSI	150KSI	120KSI	2020	8LB-FT	75LB-IN	2860	12LB-FT	9LB-FT
1/4-28	.2500	.03640	120KSI	85KSI	150KSI	120KSI	2320	10LB-FT	86LB-IN	3280	14LB-FT	10LB-FT
5/16-18	.3125	.05240	120KSI	85KSI	150KSI	120KSI	3340	17LB-FT	13LB-FT	4720	25LB-FT	18LB-FT
5/16-24	.3125	.05800	120KSI	85KSI	150KSI	120KSI	3700	19LB-FT	14LB-FT	5220	25LB-FT	20LB-FT
3/8-16	.3750	.07750	120KSI	85KSI	150KSI	120KSI	4940	30LB-FT	23LB-FT	7000	45LB-FT	35LB-FT
3/8-24	.3750	.08780	120KSI	85KSI	150KSI	120KSI	5600	35LB-FT	25LB-FT	7900	50LB-FT	35LB-FT
7/17-14	.4375	.10630	120KSI	85KSI	150KSI	120KSI	6800	50LB-FT	35LB-FT	9550	70LB-FT	55LB-FT
7/16-20	.4375	.11670	120KSI	85KSI	150KSI	120KSI	7550	55LB-FT	40LB-FT	10700	80LB-FT	60LB-FT
1/2-13	.5000	.14190	120KSI	85KSI	150KSI	120KSI	9050	75LB-FT	55LB-FT	12750	110LB-FT	80LB-FT
1/2-20	.5000	.15990	120KSI	85KSI	150KSI	120KSI	10700	90LB-FT	65LB-FT	14400	120LB-FT	90LB-FT
9/16-12	.5625	.18200	120KSI	85KSI	150KSI	120KSI	11600	110LB-FT	80LB-FT	16400	150LB-FT	110LB-FT
9/16-18	.5625	.20300	120KSI	85KSI	150KSI	120KSI	12950	120LB-FT	90LB-FT	18250	170LB-FT	130LB-FT
5/8-11	.6250	.22600	120KSI	85KSI	150KSI	120KSI	14400	150LB-FT	110LB-FT	20350	220LB-FT	170LB-FT
5/8-18	.6250	.25600	120KSI	85KSI	150KSI	120KSI	16950	180LB-FT	130LB-FT	23000	240LB-FT	180LB-FT
3/4-10	.7500	.33400	120KSI	85KSI	150KSI	120KSI	21300	260LB-FT	200LB-FT	30100	380LB-FT	280LB-FT
3/4-16	.7500	.37300	120KSI	85KSI	150KSI	120KSI	23800	300LB-FT	220LB-FT	33600	420LB-FT	320LB-FT
7/8-9	.8750	.46200	120KSI	85KSI	150KSI	120KSI	29500	520LB-FT	390LB-FT	41600	600LB-FT	460LB-FT
7/8-14	.8750	.50900	120KSI	85KSI	150KSI	120KSI	32400	570LB-FT	430LB-FT	45800	660LB-FT	500LB-FT
1-8	1.000	.60600	120KSI	85KSI	150KSI	120KSI	38600	770LB-FT	580LB-FT	54500	900LB-FT	680LB-FT
1-12	1.000	.66300	120KSI	85KSI	150KSI	120KSI	42300	850LB-FT	630LB-FT	59700	1000LB-FT	740LB-FT
1 1/8-7	1.1250	.76300	105KSI	74KSI	150KSI	120KSI	42300	800LB-FT	600LB-FT	68700	1280LB-FT	960LB-FT
1 1/8-12	1.1250	.85600	105KSI	74KSI	150KSI	120KSI	47500	880LB-FT	660LB-FT	77000	1440LB-FT	1080LB-FT
1 1/4-7	1.2500	.96900	105KSI	74KSI	150KSI	120KSI	53800	1120LB-FT	840LB-FT	87200	1820LB-FT	1360LB-FT
1 1/4-12	1.2500	1.0730	105KSI	74KSI	150KSI	120KSI	59600	1248LB-FT	920LB-FT	96600	2000LB-FT	1500LB-FT
1 3/8-6	1.3750	1.1550	105KSI	74KSI	150KSI	120KSI	64100	1468LB-FT	1100LB-FT	104000	2380LB-FT	1780LB-FT
1 3/8-12	1.3750	1.3150	105KSI	74KSI	150KSI	120KSI	73000	1680LB-FT	1260LB-FT	118400	2720LB-FT	2040LB-FT
1 1/2-6	1.5000	1.4050	105KSI	74KSI	150KSI	120KSI	78000	1940LB-FT	1460LB-FT	126500	3160LB-FT	2360LB-FT
1 1/2-12	1.5000	1.5800	105KSI	74KSI	150KSI	120KSI	87700	2200LB-FT	1640LB-FT	142200	3560LB-FT	2660LB-FT

NOTES:

1. THIS CHART SHOWS RECOMMENDED BOLT TORQUES.

2. TORQUE = R X D X T

R = .150 FOR LUB CONDITIONS

R = .200 FOR DRY CONDITIONS

TO ASSURE CONSISTENCY IN TORQUE, LUBRICATE FASTENERS WITH ENGINE OIL (MAY BE USED OIL)

D = NOMINAL DIAMETER IN INCHES

T = DESIRED CLAMP LOAD IN POUNDS = 75% PROOFLOAD X STRESS AREA

APPENDIX B



BOLT TORQUE CHART

FOR METRIC HEX HEAD CAP SCREWS

• RECOMMENDED ASSEMBLY TORQUES IN FOOT-POUNDS
(*VALUES IN LB-IN, OTHERS ARE LB-FT.)

• THE TORQUE VALUES FOR EACH DIAMETER ARE ACCEPTABLE
FOR ANY THREAD PITCH IN THAT DIAMETER.

DIAMETER	PROPERTY CLASS 8.8		PROPERTY CLASS 9.8		PROPERTY CLASS 10.9		PROPERTY CLASS 12.9	
	DRY THREADS	LUBRICATED THREADS	DRY THREADS	LUBRICATED THREADS	DRY THREADS	LUBRICATED THREADS	DRY THREADS	LUBRICATED THREADS
M4	27.5*	17*	30*	18*	38.5*	24*	53*	32.5*
M5	56.5*	33.5*	61*	37*	78*	47*	107*	65*
M6	95*	57.5*	103*	61*	132*	79*	180*	109*
M8	19	12	21	13	27	16	37	22
M10	39	23	42	25	53	32	73	44
M12	67	40	73	44	92	55	127	76
M14	107	64	116	69	146	89	203	122
M16	167	100	181	108	230	138	316	190
M20	325	195	352	211	449	269	617	370
M24	562	337	609	386	775	465	1066	640
M30	1117	670	1210	726	1540	924	2188	1271

CALAVAR SELF-PROPELLED CONDOR

ILLUSTRATED PARTS LIST

Figure Number	Title	Model
1	Final Assembly	50
1A	Final Assembly	58, 56
1B	Final Assembly	48
1C	Safety Decals and Placards	
2	Carriage Weldment	
3	Carriage Assembly	48, 50, 58, 68
3C	Four Wheel Drive Option	50, 58, 68
3D	Four Wheel Drive Steering Assembly	
4	Torque Drive Assembly W/Modular Valve	
4A	Modular Valve	
5	Hub, Spindle and Stub Axle Assembly	50, 58, 68
5A	Hub, Spindle and Stube Axle Assembly	48
6	Tire-Wheel Assembly	50, 58, 68
6A	Tire-Wheel Assembly	48
7	Steering Assembly	
8	Steering Cylinder	
9	Rotary Coupling	
10	Turret Assembly (all models, except battery powered)	
11	Turre Proportional Valve System Installation	
11A	Turret Proportional Valve System Diagram Installation	
12	Turret Proportional Control Valve Assembly	
13	Turret Pump Installation	
14	Fuel Tank Assembly	
15	Hydraulic Tank Assembly	
16	Ground Control Box Assembly	
17	Turret Rotation Speed Reducer Installation	
18	Muffler Installation	
19	Air Cleaner, Warning Horn and Battery Installation	
21	Boom Assembly	58, 68
21A	Boom Assembly	48
21B	Boom Assembly	50
23	Slave Leveling Cylinder Assembly	
23-A	Slave Leveling Cylinder	
24	Master Leveling Cylinder	
25	Boom Extension Cylinder Assembly	50
25A	Boom Extension Cylinder	50
26	Boom Extension Cylinder Assembly	48
26A	Boom Extension Cylinder	48
26B	Boom Extension Cylinder Assembly	58
26C	Boom Extension Cylinder	58
26D	Boom Extension Cylinder Assembly	68
26E	Boom Extension Cylinder	68
28	Topping Cylinder	48
28A	Topping Cylinder	50
28B	Topping Cylinder	58, 68

Figure
Number

Title

Model

29	Platform Assembly, No rotation	
31	Platform Control Console Assembly	
32	Platform Weldment	

CALAVAR SELF-PROPELLED CONDOR

LIST OF OPTIONS

Option Number	Title	Figure Number
32746	180° Platform Rotation Assembly	35
21057	Air Line	36
Standard	110 V Electric Line Inside Boom with Receptacle at Base and Platform	37
21059	Rotating Beacon	38
21060	Headlight and Tail light for In-Plant Operation	39
21062	12 Volt Platform Work Light	40
32753	4' x 36" x 42" Platform Weldment	42
32769	6' x 36" x 42" Platform Weldment	42
32770	8' x 36" x 42" Platform Weldment	42
21066	Diesel Engine Assembly	43
21069	LP Gas Assembly	44
21071	Descent Horn	45
21292	Platform Deadman Switch	46
21072	Platform Automobile Type Horn	47
21647	110 Volt Shaft Driven Alternator	48
21648	Auxiliary Hydraulic Power Pack Installation - Gas Engine	49
21651	Lifting Eyes	54
21385	Spark Arrestor	56
21063	Foam Filled Tires	**
21064	Solid Tires	**
21156	Special Paint (one color)	**
21440	In-Plant Towing	**
21283	Safety Belt (extra)	**

** Not Illustrated

INTRODUCTION

The primary purpose of this manual is to provide the user with a thorough understanding of the proper operating procedures necessary to comply with the intended use of the CONDOR®, and to provide the information necessary to maintain and service the CONDOR®.

THE OPERATOR'S MANUAL MUST BE RETAINED ON THE CONDOR® AT ALL TIMES.

Do not attempt to operate or service the CONDOR® until you have read and understood all information provided in this manual. Familiarize yourself with the functions and operations of the upper and lower controls. A good understanding of the controls, their limitations, and their capabilities will maximize operating efficiency. The various decals attached to this CONDOR® also contain vital operational instructions. Read the decals before operating this CONDOR®.

It is YOUR RESPONSIBILITY to follow procedures while operating the CONDOR®. The manufacturer of this CONDOR® cannot control the wide range of applications that may be used in carrying out a variety of jobs. Therefore, it is THE USER'S RESPONSIBILITY to consider all personnel when making decisions regarding the CONDOR®'s intended use.

It is also YOUR RESPONSIBILITY to understand and obey all federal, state, and local regulations regarding the operation and use of aerial work platforms. A copy of the ANSI/SIA Manual of Responsibilities is attached for your use: ANSI/SIA A92.5-1992 is provided for Boom-Supported Elevating Work Platforms, and ANSI/SIA A92.6-1990 is provided for Self-Propelled Elevating Work Platforms.

TIME CONDOR Corporation reserves the right to modify, improve, add, and/or delete certain design features of its products without any obligation to incorporate new features into products previously sold. Our manuals are continually updated to reflect these changes.

*DO NOT ALTER OR MODIFY THIS CONDOR® WITHOUT PRIOR WRITTEN APPROVAL
FROM THE MANAGEMENT OF THE TIME CONDOR Corporation.*

SERVICE & MAINTENANCE

Many of the parts used in the manufacture of the CONDOR® have specific properties, and the manufacturer recommends that replacement parts be purchased through the TIME CONDOR Corporation in order to ensure the original integrity of the product. Repairs and adjustments should only be made by trained and qualified personnel. Please refer to the maintenance and parts sections of the TIME CONDOR Corporation Operation, Maintenance, & Parts Manual for information on service and maintenance of the CONDOR®.

NOTE: Please refer to the TIME CONDOR Corporation Parts section of the Operation, Maintenance, & Parts Manual for information pertaining to your CONDOR®.



CONDOR® SERVICE INFORMATION

1. If you need assistance or have any service or maintenance questions, TIME CONDOR Corporation service and parts personnel are always available by phone or fax. The telephone numbers are:

(254) 420-5200 Telephone
(254) 420-5298 Voice Mail
(800) 443-5803 FAX

2. There are numerous written Maintenance Procedures available for this machine. These procedures are available through the TIME CONDOR Corporation Service Department to anyone who requests them.
3. Service and maintenance are not a substitute for trained, qualified service technicians. TIME CONDOR Corporation conducts service schools on a continuing basis. Call any of our service or sales persons for a schedule. Remember, training of mechanics is the responsibility of their employer, but TIME CONDOR Corporation. Service Schools help you provide this training.
4. TIME CONDOR Corporation Service School Training Manuals are available for purchase through the parts department. The part numbers for these manuals are: #92333 for self-propelled models; and #92334 for truck-mounted models.

TIME CONDOR Corporation

How to Order Parts

1. When ordering parts for your **CONDOR®**, ensure that you are able to give the model and serial numbers of all units for which parts are needed. The serial number(s) will assist the TIME CONDOR Corporation Parts Department in providing the correct parts for your machine(s). Please refer to FIGURE A for Serial Number Location on this model.
2. If known, please specify the TIME CONDOR Corporation part number(s) for the part(s) you require, and always provide a complete description of all parts.
3. Fax orders are preferable, though parts may also be ordered by mail and telephone. A sample parts order (with fax number) follows this page.
4. Parts needed for a warranty repair must be purchased through the TIME CONDOR Corporation Parts Department. Credit will be authorized through the Service Department after a Warranty Claim has been submitted to TIME CONDOR Corporation. A Warranty Claim is to be filed for any part received as "defective".
5. TIME CONDOR Corporation will ship parts as per our customers' request at the time of the order—i.e., UPS, Federal Express, or preferred truck line. When shipping Federal Express, your customer account must be given at the time of the order.
6. TIME CONDOR Corporation classifies its orders in the following ways:
 - Emergency (unit out of service) - Top priority. Shipping deadline for emergency orders to ship same day is 2:00 p.m. Central Standard Time. Any emergency order received after 2:00 p.m. will be shipped the following day.
 - Stock Order to be shipped within (1) week.
7. TIME CONDOR Corporation has a \$25.00 Net Minimum Billing charge per order.
8. All price quotations will be valid for 90 days.
9. Parts shown as shipped on the TIME CONDOR Corporation packing list and subsequent invoice but not received by the dealer/customer MUST be reported within 10 days after the date of shipment. If the parts are still required, a NEW parts order must be submitted. Shortages and discrepancies will be reviewed on an individual basis by the Parts staff and adjustments will be made accordingly.
10. Invoice discrepancies regarding incorrect prices or discounts should be reported immediately to the Parts Department. Report the Sales Order number, Purchase Order number, and Invoice number. Your request will be reviewed and adjustments will be made accordingly.

CONDOR PARTS DEPARTMENT
FAX ORDER FORM FAX NO. 800-443-5803

[illegible]



CALAVAR CORPORATION

Self – Propelled Booms and Scissors WARRANTY

Calavar Corporation ("Calavar") warrants to the purchaser that each new aerial work platform made by Calavar is free from defects in material and workmanship arising under normal use and service, in the case of major weldments (chassis, turret and booms), for a period of **5** years after the original shipment of the aerial work platform from Calavar's plant; and in the case of all other parts, for a period of **1** year after the aerial work platform is first placed in service or **two** years after the original shipment of the aerial work platform from Calavar's plant, whichever occurs first.

The obligation and liability under this Warranty is expressly limited to repairing or, at Calavar's option, replacing free of charge, at its factory in Waco, Texas or at an authorized repair facility designated by Calavar, the defective part. In no event shall Calavar or its suppliers be liable to the purchaser or any other person for transportation charges or for any incidental, collateral, special or consequential damages, including without limitation damages for loss of profits, loss of customers, loss of goodwill or work stoppage, claims by any party other than the purchaser, or any other similar damages or loss even if Calavar, its suppliers or its representatives have been advised of the possibility of such damages.

Parts claimed to be defective and for which repair or replacement is desired shall be returned transportation **prepaid** to Calavar's factory for inspection. This Warranty applies to replacement parts provided under the terms of this Warranty only for the remainder of the Warranty period applicable to the original purchase.

Any operation of the equipment beyond rated capacity, improper use or application of the equipment, substitution upon it of parts not approved by Calavar or alteration or repair of the equipment by any person not authorized by Calavar shall, at Calavar's option, void this Warranty. Calavar shall have no liability or responsibility for damages resulting from accident or the malfunction of equipment and components not supplied by Calavar.

No agent, employee, distributor, dealer or other representative of Calavar is authorized to modify this Warranty in any way. Accordingly, additional statements or presentations by any such representative, whether oral or written, do not constitute warranties by Calavar and should not be relied upon as limited warranties of Calavar, and no attempt, effort or promise to repair equipment by Calavar or any such representative at any time shall modify or extend this Warranty in any way. If the purchaser has used its own order form, no additional or different warranty terms contained in purchaser's form will be honored by Calavar. This Warranty covers only new and unused aerial work platforms manufactured by Calavar. Products or parts manufactured by others are covered only by such warranties as are extended to the purchaser by Calavar's suppliers.

This Warranty is in lieu of all other warranties, expressed or implied, including but not limited to warranties of merchantability and fitness for a particular purpose. Any applicable implied warranty shall be limited in duration to the warranty period.

8300 Imperial Drive, P.O. Box 21447, Waco, Texas 76702-1447 • 817-666-4545, 817-666-4544 FAX

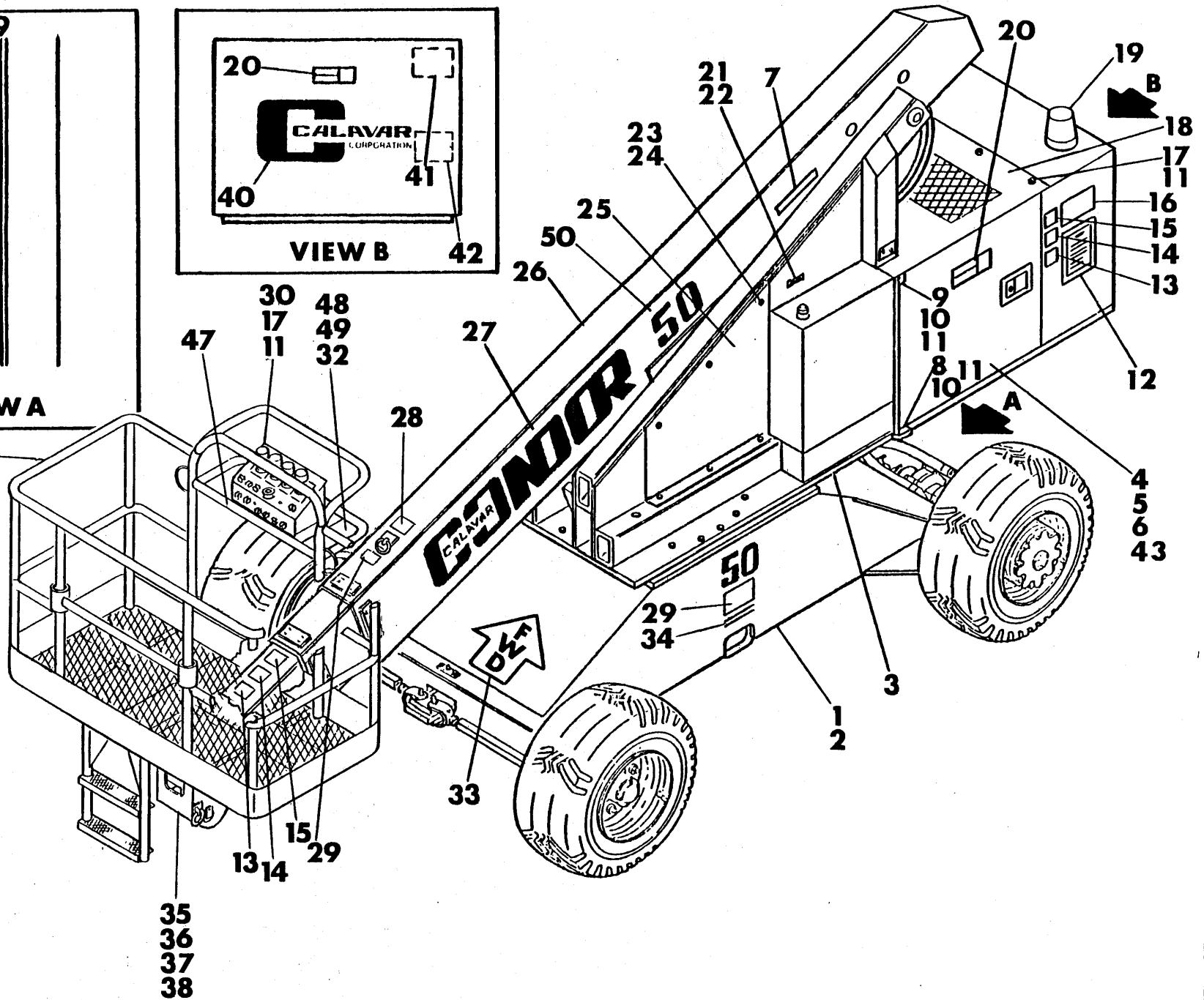
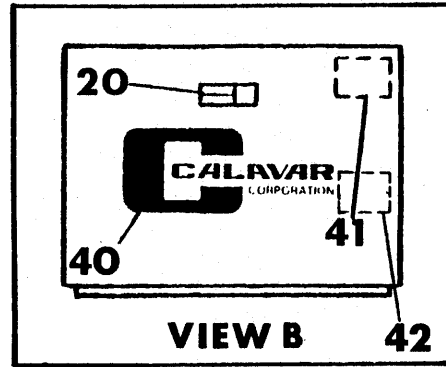
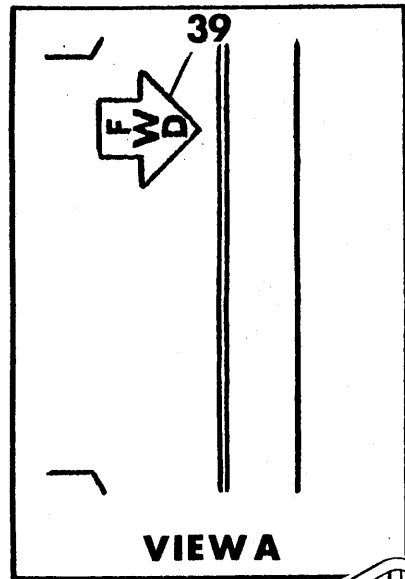


FIGURE 1 - FINAL ASSEMBLY (50)

FIGURE 1 - FINAL ASSEMBLY (50)

REF	DESCRIPTION	PART NUMBER	QTY
1-	Final Assembly	40810 (50)	1
-1	Carriage Weldment	(see figure 2)	1
-2	Carriage Assembly	(see figure 3)	1
-3	Turret Assembly	(see figure 10)	1
-4	Door - Left	40068	1
-5	Door - Right	40067	1
-6	Decal - "Do Not Left Wheels with Boom" (inside of both doors & both sides of inner boom)	21971-2(Ref. Fig. IC #3)	4
-7	Decal - "Lube Fitting	21079 (50)	1
-8	Lower Hinge Block	21790	2
-9	Upper Hinge	21795	2
-10	Hex Head Capscrew	1/4- 28 UNF x 1	4
-11	Lockwasher	1/4	14
-12	Nameplate - Operation Instructions	21415(Ref. Fig. IC #12)	1
-13	Decal - Hazard & Accident Prevention	21882-2(Ref. Fig. IC #11)	2
-14	Decal - Hazard & Accident Prevention	21882-3(Ref. Fig. IC #6)	2
-15	Decal - Hazard & Accident Prevention	21882-4(Ref. Fig. IC #10)	2
-16	Nameplate - Caution	21854(Ref. Fig. IC #13)	1
-17	Hex Head Capscrew	1/4 - 20 UNC x 1/2 LG.	10
-18	Engine Hood	40066	1
-19	Rotating Beacon (Option 21059)	(see figure 38)	1
-20	Decal - Hazard Accident Prevention	21882-1(Ref. Fig. IC #15)	3
-21	Nameplate -Hydraulic Fluid (Nearside)	21850	1
-22	Nameplate - Gas (Farside)	21849	1
-23	Hex Head Capscrew	3/8 - 24 UNF x 1/2 LG.	6
-24	Lockwasher	3/8	6
-25	Turret Side Plate	21794	1
-26	Boom Assembly (50)	(see figure 21C)	1
		40853	1
-27	Decal - Condor	21834	2
-28	Nameplate - Caution & Warning	21416(Ref. Fig. IC #1)	1
-29	Nameplate - Transportation	40783(Ref. Fig. IC #2)	2
-30	Platform Control Console	(see figure 31) 40670	1
-31	Platform Weldment, 36" x 60"	(see figure 32)	1
-32	Nameplate - Platform Capacity	40811 (50)(Ref. Fig. IC #7)	1
-33	Decal - "FWD"	21873-2	1
-34	Decal - "Tire Pressure 70 PSI"	21971-6 (Ref. Fig. IC #19)	2
-35	Hex Head Capscrew	7/16-14 UNC x 3-1/2	4
-36	Lockwasher	7/16	4
-37	Hex Nut	7/16 - 14 UNC	4
-38	Flat Washer	7/16	8
-39	Decal - "FWD"	21873-1	1
-40	Decal - "Calavar Corporation	15430	1
-41	Nameplate - Serial Number (Farside)	15843 (Ref. Fig. IC #21)	1
-42	Decal - "Battery Replacement"	21399 (Ref. Fig. IC #20)	1
-43	Decal - "Operation and Safety Manual" (on holder inside compartment)	21384	1

FIGURE 1 - FINAL ASSEMBLY

(50)

REF	DESCRIPTION	PART NUMBER	QTY
-44	Safety Belt Assembly	21280	1
-45	Lanyard	21281	1
-46	Belt	21238	1
-47	Decal - "Caution & Warning"	32200 (Ref. Fig. IC #9)	1
-48	Decal - "5° Slope"	21880 (Ref. Fig. IC #5)	1
-49	Decal - "Turret Lock Pin"	40191 (Ref. Fig. IC #16)	3
-50	Decal - " 50 "	40791-10	4
-51	Decal - "Travel Speed"	40130 (Ref. Fig. IC #14)	1

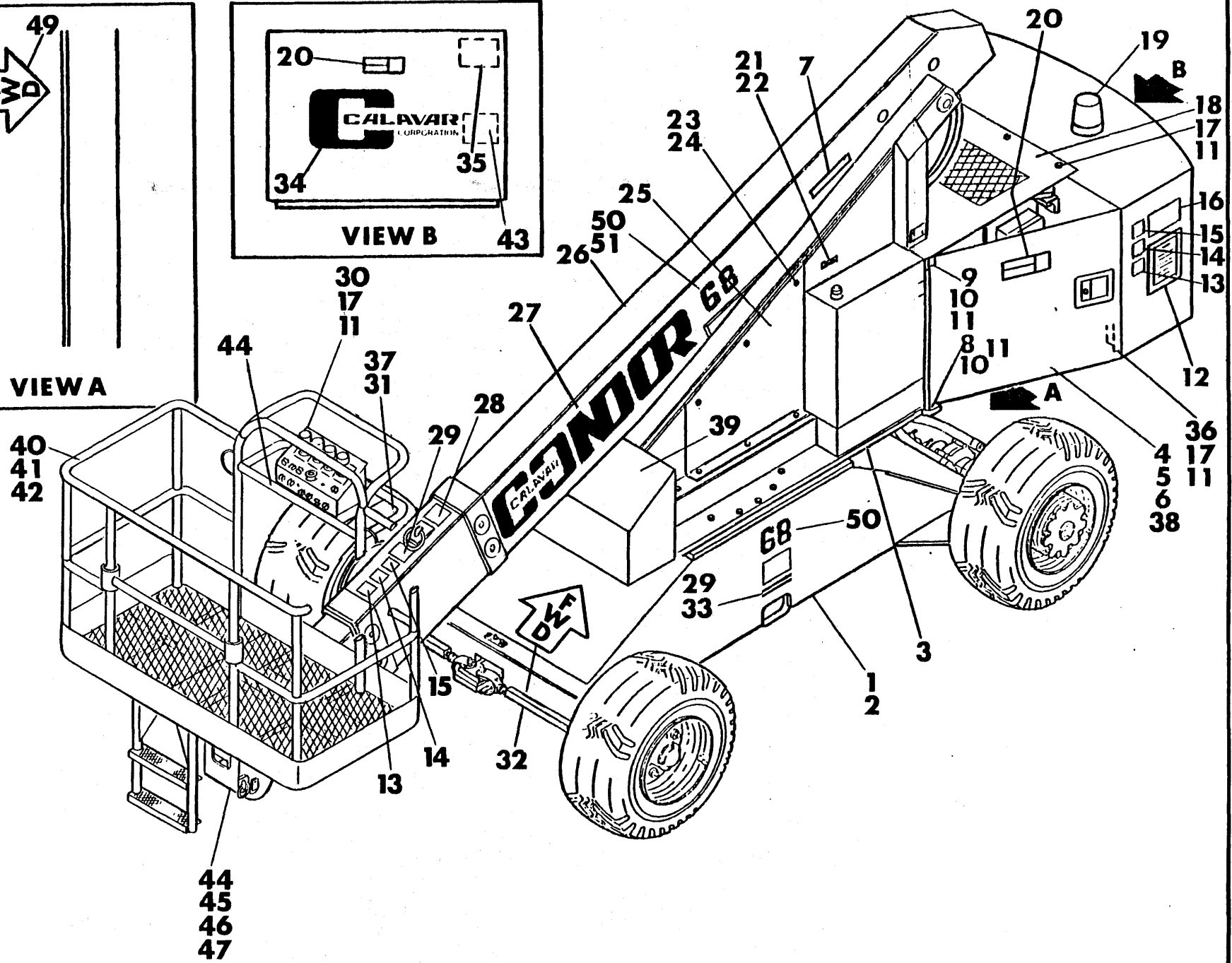
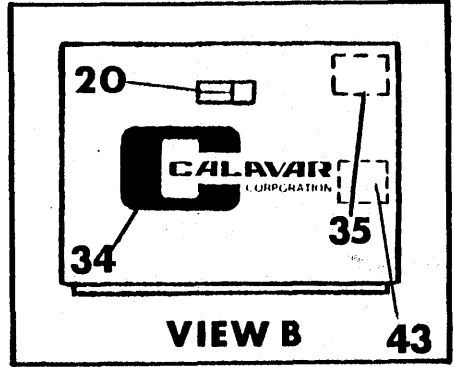
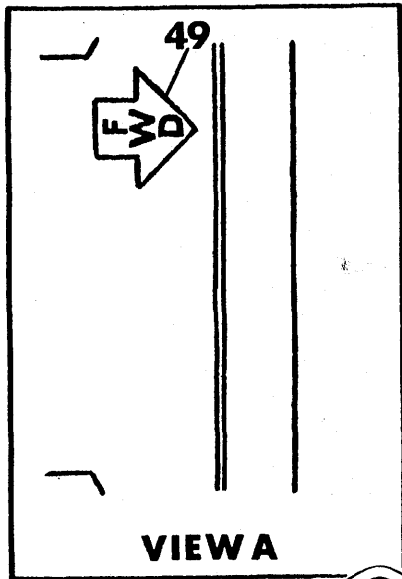


FIGURE 1A- FINAL ASSEMBLY (58,68)

FIGURE 1A - FINAL ASSEMBLY (58, 68)

REF	DESCRIPTION	PART NUMBER	QTY
1A-	Final Assembly	58000 (58)	1
		68000 (68)	1
- 1	Carriage Weldment	(See Fig. 2)	1
- 2	Carriage Assembly	(See Fig. 3)	1
- 3	Turret Assembly	(See Fig. 10)	1
- 4	Door - Left	40068	1
- 5	Door - Right	40067	1
- 6	Decal "Do Not Lift Wheels with Boom" (inside of Both Doors and both sides of inner boom)	21971-2 (Ref. Fig. IC #3)	4
- 7	Decal "'Lube Fitting"	21079	1
- 8	Lower Hinge Block	21790	2
- 9	Upper Hinge	21795	2
-10	Hex Head Capscrew	1/4-28 UNF X 1	4
-11	Lockwasher	1/4	20
-12	Nameplate-Operation Instructions	21415 (Ref. Fig. IC #12)	1
-13	Decal-Hazard & Accident Prevention	21882-2 (Ref. Fig. IC #11)	2
-14	Decal-Hazard & Accident Prevention	21882-3 (Ref. Fig. IC #6)	2
-15	Decal-Hazard & Accident Prevention	21882-4 (Ref. Fig. IC #10)	2
-16	Nameplate-Caution	21854 (Ref. Fig. IC #13)	1
-17	Hex Head Capscrew	1/4-28 UNC X 1/2	10
-18	Engine Hood	40066	1
-19	Rotating Beacon (option 21059)	(See Fig. 38)	1
-20	Decal-Hazard & Accident Prevention	21882-1 (Ref. Fig. IC #15)	3
-21	Nameplate-Hydraulic Fluid (Near side)	21850	1
-22	Nameplate-Gas (Far side)	21849	1
-23	Hex Head Capscrew	3/8-18 UNF X 1/2	6
-24	Lockwasher	3/8	6
-25	Turret Side Plate	21794	1
-26	Boom Assembly 68019 (68), 58019 (58)	(See Fig. 21)	1
-27	Decal "Condor"	21834	2
-28	Nameplate-Caution & Warning	21416 (Ref. Fig. IC #1)	1
-29	Nameplate - Transportation	40783 (Ref. Fig. IC #2)	3
-30	Platform Control Console	(See Fig. 31)	1
-31	Nameplate - Platform Capacity (Ref. Fig. IC #7A, 7C)	68031 (68), 58021 (58)	1
-32	Decal - "FWD"	21873-2	1
-33	Decal - "Tire Pressure 75PSI"	21971-5 (Ref. Fig. IC #17)	2
-34	Decal - "Calavar Corporation"	15430	1
-35	Nameplate - Serial Number (Far side)	15843 (Ref. Fig. IC #21)	1
-36	Door Stop	21868	2
-37	Nameplate - Caution (5° Automatic Slope Control)	21880 (68, 58) (Fig. IC #5)	1
-38	Decal - "Operation and Safety Manual " (on holder inside compartment)	21384	1
-39	Front counterweight	21738	1
-40	Safety Belt Assembly	21280	1
-41	Lanyard	21281	1
-42	Belt	21238	1

FIGURE 1A - FINAL ASSEMBLY (58,68)

REF	DESCRIPTION	PART NUMBER	QTY
43	Decal - "Battery Replacement"	21399 (Ref. Fig. IC #20)	1
44	Decal - "Caution & Warning"	32200 (Ref. Fig. IC #9)	1
45	Capscrew, Hex Head	7/16 - 14 UNC x 3 1/2	4
46	Lockwasher	7/16	4
47	Nut, Hex	7/16 - 14 UNC	4
48	Flat Washer	7/16	8
49	Decal - " FWD "	21873-1	1
50	Decal - " 58 "	40791-5	2
51	Decal - " 68 "	40791-6	2
52	Decal - "Travel Speed"	40130 (Ref. Fig. IC #14)	1
53	Decal - "Turret Lock Pin"	40191 (Ref. Fig. IC #16)	3

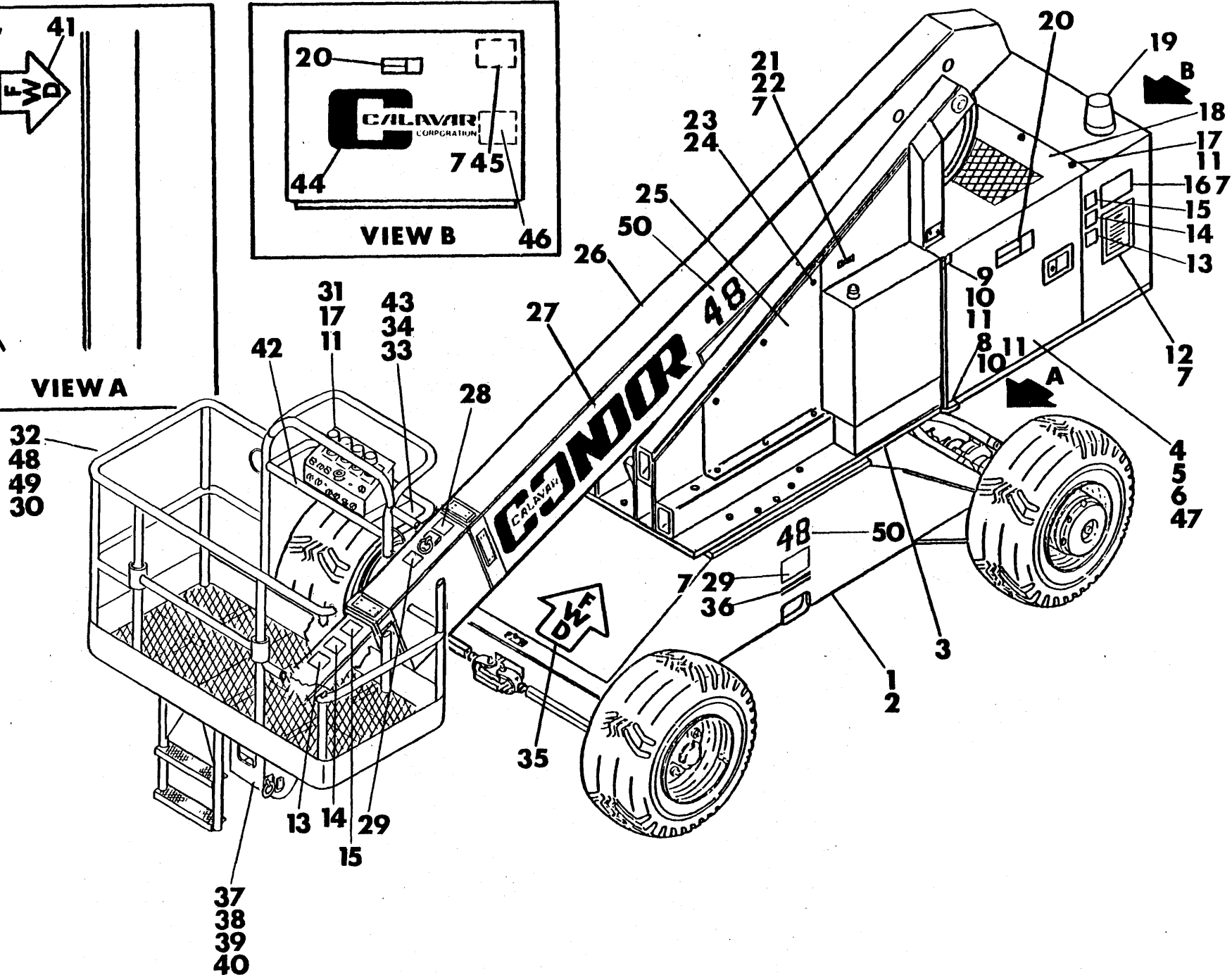
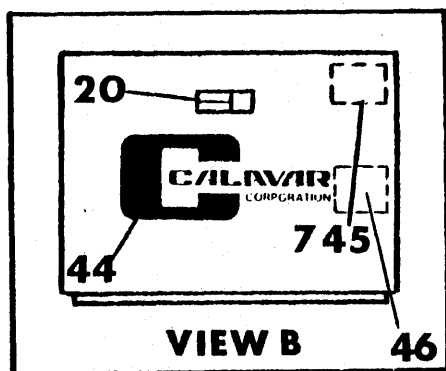
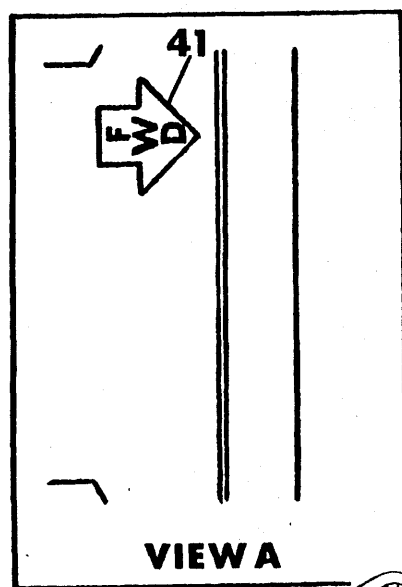


FIGURE 1B - FINAL ASSEMBLY (48)

FIGURE 1B - FINAL ASSEMBLY (48)

REF	DESCRIPTION	PART NUMBER	QTY
1C	Final Assembly	40780	1
1-	Carriage Weldment	(See Fig. 2)	1
2-	Carriage Assembly	(See Fig. 3A)	1
3-	Turret Assembly	(See Fig. 10)	1
4-	Door-Left	40068	1
5-	Door-Right	40069	1
6-	Decal-"Do Not Lift Wheels with Boom"	21971-2 (Fig. 1C #3)	4
7-	Rivet	4-3565	48
8-	Lower Hinge Block	21790	2
9-	Upper Hinge	21795	2
10-	Hex Head Capscrew	1/4-28 UNF x 1	4
11-	Lockwasher	1/4	14
12-	Nameplate-Operation Instructions	40127 (Fig. 1C #8)	1
13-	Decal-Hazard & Accident Prevention	21882-2 (Fig. 1C #11)	2
14-	Decal-Hazard & Accident Prevention	21882-3 (Fig. 1C #6)	2
15-	Decal-Hazard & Accident Prevention	21882-4 (Fig. 1C #10)	2
16-	Nameplate-Caution	21854 (Ref. Fig. 1C #13)	1
17-	Hex Head Capscrew	1/4-20 UNC x 1/2	10
18-	Engine Hood	40066	1
19-	Rotating Beacon (Option 21059)	(See Fig. 38)	1
20-	Decal-Hazard & Accident Prevention	21882-1 (Fig. 1C #15)	3
21-	Nameplate-Hydraulic Fluid (Near side)	21850	1
22-	Nameplate-Gas (Far side)	21849	1
23-	Hex Head Capscrew	3/8 - 24 UNF x 1/2 LG.	6
24-	Lockwasher	3/8	6
25-	Turret Side Plate	21794	1
26-	Boom Assembly	(See Fig 21A)	1
27-	Decal "Condor"	21834	2
28-	Nameplate-Caution & Warning	21416 (Ref. Fig. 1C #1)	1
29-	Nameplate-Transportation	40783 (Ref. Fig. 1C #2)	2
30-	Belt	21238	1
31-	Platform Control Console	(See Fig. 31)	1
32-	Platform Weldment, 36" x 60"	(See Fig. 32)	1
33-	Nameplate-Platform Capacity	40784 (Ref. Fig. 1C #7B)	1
34-	Decal-"Turret Lock Pin"	40191 (Ref. Fig. 1C #16)	1
35-	Decal-"FWD"	21873-2	1
36-	Decal-"Tire Pressure 65 PSI"	21971-3 (Ref. Fig. #18)	2
37-	Hex Head Capscrew	7/16-14 UNC x 3-1/2	4
38-	Lockwasher	7/16	4
39-	Hex Nut	7/16-14 UNC	4
40-	Flat Washer	7/16	8
41-	Decal-"FWD"	21873+1	1
42-	Decal-"Caution & Warning	32200 (Ref. Fig. 1C #9)	1
43-	Decal "5° Slope"	21880 (Ref. Fig. 1C #5)	1
44-	Decal-"Calavar Corporation"	15430	1
45-	Nameplate-Serial Number (Far side)	15843 (Ref. Fig. 1C #21)	1
46-	Decal-"Battery Replacement"	21399 (Ref. Fig. 1C #20)	1
47-	Decal-"Travel Speed"	40130 (Ref. Fig. 1C #14)	1

FIGURE 1C SELF - PROPELLED CONDOR SAFETY DECALS & PLACARDS

1

CALAVAR CONDOR

CAUTION

DO NOT OPERATE THE AERIAL LIFT WITH THE VEHICLE ON SLOPES IN EXCESS OF 5 DEGREES IN COMPLIANCE WITH ANSI BULLETIN A92.2 - 1969.

TRAVEL CONFIGURATION

NORMAL TRAVEL POSITION THE BOOM SHALL BE RETRACTED, POSITIONED OVER THE DRIVING AXLE AND ELEVATED TO PROVIDE ADEQUATE GROUND CLEARANCE FOR THE PLATFORM.

WARNING

SEVERE DAMAGE TO BOOM CABLE ASSEMBLIES WILL BE CAUSED BY-

- A) DRIVING EXTENDED BOOM INTO STATIONARY OBJECTS.
- B) DRIVING OBJECTS INTO STATIONARY BOOM.

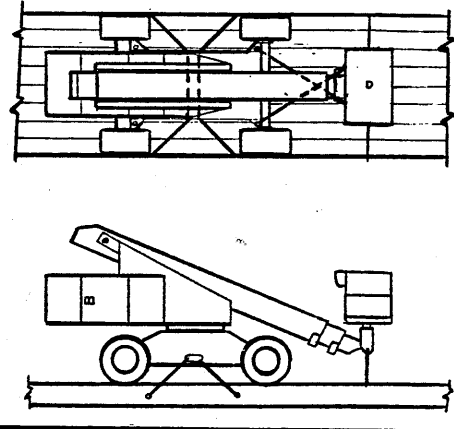
VISUAL INSPECTION OF BOOM EXTENSION CABLES MUST BE ACCOMPLISHED PERIODICALLY TO DETERMINE ANY DAMAGE. DAMAGED CABLES MUST BE REPLACED IMMEDIATELY. FAILURE TO DO SO WILL RESULT IN A DANGEROUS CONDITION TO OPERATOR AND EQUIPMENT.

21416

21416

2

**FACTORY RECOMMENDED
TRANSPORTING DIAGRAM**



40783

2- Also located opposite side and on rear of carriage.

3

**DO NOT LIFT WHEELS
WITH BOOM**

21971-2

21971-2

3- Also located on opposite side and inside of both doors.

4



115 VAC BEFORE ENERGIZING 115 VAC, ALLOW A 2 MINUTE DELAY AFTER ENGINE SHUT OFF.
DO NOT ATTEMPT TO START ENGINE WITH THIS SWITCH ON.

21769

4- Option 21647

21769

5

CAUTION

THIS SELF-PROPELLED CONDOR IS EQUIPPED WITH SLOPE SENSORS AND INDICATOR LIGHT.

WHEN BOOM IS ABOVE HORIZONTAL AND THE MACHINE IS BEING DRIVEN UP, DOWN, OR ON A SIDE GRADE AT 5° OUT OF LEVEL, THE INDICATOR LIGHT WILL COME ON AND ALL BOOM FUNCTIONS WILL BE INOPERABLE.

TO CORRECT CONDITION---(DO NOT LOWER BOOM WITH EMERGENCY LOWERING). REVERSE DIRECTION OF GROUND TRAVEL UNTIL LIGHT GOES OUT INDICATING THE CONDOR IS AGAIN LESS THAN 5° OUT OF LEVEL AND THE BOOM FUNCTIONS ARE AGAIN OPERABLE.

21880

6



YOU MUST NOT OPERATE THIS DEVICE UNLESS:

- 1. YOU HAVE BEEN TRAINED IN THE SAFE OPERATION OF THIS DEVICE, AND
- 2. YOU KNOW AND FOLLOW THE SAFETY AND OPERATING RECOMMENDATIONS CONTAINED IN THE MANUFACTURER'S MANUALS, YOUR EMPLOYER'S WORK RULES AND APPLICABLE GOVERNMENTAL REGULATIONS.

AN UNTRAINED OPERATOR SUBJECTS HIMSELF AND OTHERS TO DEATH OR SERIOUS INJURY.

5771012-A

21882-3

7

CONDOR 50 LOAD CAPACITY
1250 LBS.
Capacity Includes Personnel&Equipment

40811

7A

CONDOR 58 LOAD CAPACITY
1250 LBS.
Capacity Includes Personnel&Equipment

58021

7B

CONDOR 48 LOAD CAPACITY
1000 LBS.
Capacity Includes Personnel&Equipment

40784

7C

CONDOR 68 LOAD CAPACITY
800 LBS.
Capacity Includes Personnel&Equipment

68031

8

CALAVAR SELF-PROPELLED CONDOR

WARNING-

BEFORE OPERATING UNIT, READ AND UNDERSTAND ALL OPERATING AND SAFETY INFORMATION IN THE MANUAL AND ON ALL PLACARDS.

REFER TO INDIVIDUAL PLACARDS FOR SPECIFIC INSTRUCTIONS AT EACH CONTROL STATION.

GENERAL INSPECTION-

DAILY-

- 1- CHECK HYDRAULIC FLUID LEVEL.
- 2- CHECK BATTERY WATER LEVEL.
- 3- ROUTINE INSPECTION FOR STRUCTURAL DEFECTS.
- 4- INSPECT FOR DETERIORATION (A) FLUID LINES, (B) ELECTRICAL CIRCUITS,
- 5- CHECK ENGINE OIL AND FUEL LEVEL.

MAXIMUM INTERVALS OF 50 HOURS-

- 1- CHECK GEAR BOX LUBE LEVELS.
- 2- GREASE ALL PRESSURE GUN FITTINGS.
- 3- INSPECT WHEEL DRIVE COMPONENTS.
- 4- INSPECT STEERING COMPONENTS, AND WHEEL NUTS.
- 5- INSPECT BRAKE COMPONENTS. AND FLUID LEVEL.

GENERAL OPERATING INSTRUCTIONS -

- 1- TURN MASTER SWITCH ON AT GROUND CONTROL STATION.
- 2- POSITION SELECTOR SWITCH TO GROUND CONTROL, AND TEST OPERATE ALL AERIAL FUNCTIONS FROM THE GROUND CONTROL STATION.
- 3- POSITION SELECTOR SWITCH TO AERIAL POSITION.
- 4- REFER TO WORK PLATFORM INSTRUCTION PLACARDS FOR ALL OPERATIONS IN THE PLATFORM.
- 5- REFER TO THE PLACARD ON THE REMOTE CONTROL BOX FOR OPERATIONS FROM THE REMOTE STATION.

40127

9

WARNING THIS UNIT IS NOT INSULATED AND
MUST NOT BE OPERATED NEAR ENERGIZED POWER LINES

32200

10

CAUTION

1. INSPECT VEHICLE AND AERIAL DEVICE, INCLUDING OPERATION, PRIOR TO USE, DAILY.
2. FOR STATIONARY OPERATION VEHICLE MUST BE SECURELY PARKED AND STABILIZED FOR THE WORK TO BE PERFORMED BEFORE AERIAL DEVICE IS OPERATED.
3. OUTRIGGERS WHEN REQUIRED MUST BE ON SOLID FOOTING.
4. OPERATORS SHALL WEAR A BODY BELT, AND ATTACH WITH A LANYARD TO BOOM OR PLATFORM.
5. OPERATE ALL CONTROLS SLOWLY FOR SMOOTH PLATFORM MOTION.
6. DO NOT LOAD BEYOND RATED CAPACITY.

21882-4

11



ELECTROCUTION HAZARD

THIS MACHINE IS NOT INSULATED

MAINTAIN SAFE CLEARANCES FROM ELECTRICAL POWER LINES AND APPARATUS. YOU MUST ALLOW FOR PLATFORM SWAY, ROCK, OR SAG.

THIS AERIAL DEVICE DOES NOT PROVIDE PROTECTION FROM CONTACT WITH OR PROXIMITY TO AN ELECTRICALLY CHARGED CONDUCTOR.

DEATH OR SERIOUS INJURY WILL RESULT FROM SUCH CONTACT OR INADEQUATE CLEARANCE.

2751006-A

21882-2

12

CALAVAR SELF-PROPELLED CONDOR

WARNING-

BEFORE OPERATING UNIT, READ AND UNDERSTAND ALL OPERATING AND SAFETY INFORMATION IN THE MANUAL AND ON ALL PLACARDS.

REFER TO INDIVIDUAL PLACARDS FOR SPECIFIC INSTRUCTIONS AT EACH CONTROL STATION.

GENERAL INSPECTION-

DAILY-

- 1- CHECK HYDRAULIC FLUID LEVEL.
- 2- CHECK BATTERY WATER LEVEL.
- 3- ROUTINE INSPECTION FOR STRUCTURAL DEFECTS.
- 4- INSPECT FOR DETERIORATION (A) FLUID LINES, (B) ELECTRICAL CIRCUITS, (C) BOOM EXTENSION CABLES.
- 5- CHECK ENGINE OIL AND FUEL LEVEL.

MAXIMUM INTERVALS OF 50 HOURS-

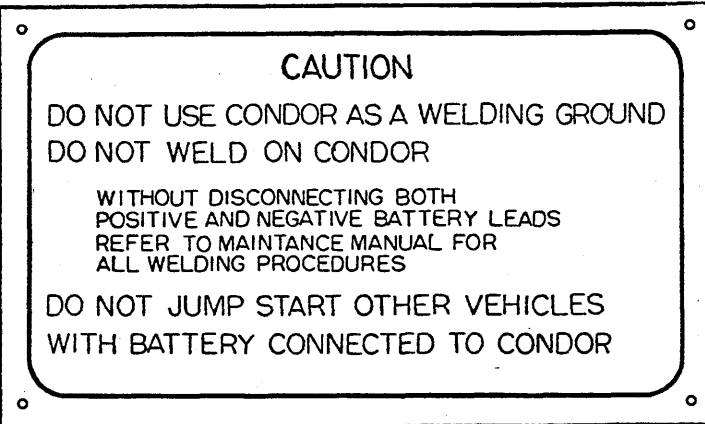
- 1- CHECK GEAR BOX LUBE LEVELS.
- 2- GREASE ALL PRESSURE GUN FITTINGS.
- 3- INSPECT WHEEL DRIVE COMPONENTS.
- 4- INSPECT STEERING COMPONENTS, AND WHEEL NUTS.
- 5- INSPECT BRAKE COMPONENTS, AND FLUID LEVEL.
- 6- VISUALLY INSPECT ALL MECHANICAL BOOM CABLES FOR ANY SIGNS OF DAMAGE. REPLACE IMMEDIATELY ANY DAMAGED CABLE. CONTINUED USE OF CONDOR WILL RESULT IN A DANGEROUS CONDITION TO OPERATOR AND EQUIPMENT.

GENERAL OPERATING INSTRUCTIONS-

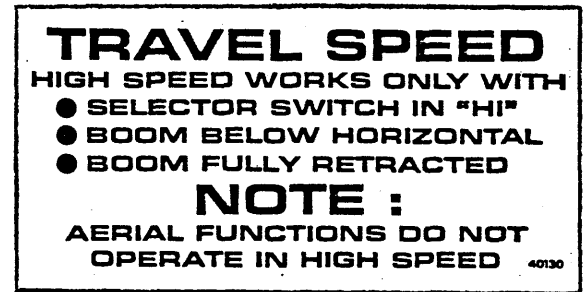
- 1- TURN MASTER SWITCH ON AT GROUND CONTROL STATION.
- 2- POSITION SELECTOR SWITCH TO GROUND CONTROL, AND TEST OPERATE ALL AERIAL FUNCTIONS FROM THE GROUND CONTROL STATION.
- 3- POSITION SELECTOR SWITCH TO AERIAL POSITION.
- 4- REFER TO WORK PLATFORM INSTRUCTION PLACARDS FOR ALL OPERATIONS IN THE PLATFORM.
- 5- REFER TO THE PLACARD ON THE REMOTE CONTROL BOX FOR OPERATIONS FROM THE REMOTE STATION.

21415

13

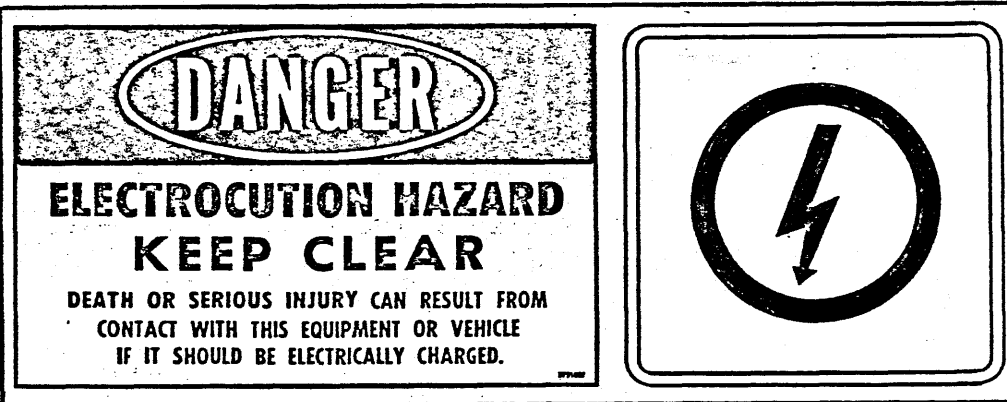


14



21854

15



21882-1

17

TIRE PRESSURE 75 PSI

21971-5

18

TIRE PRESSURE 65 PSI

21971-3

19

TIRE PRESSURE 70 PSI

21971-6

16



#20 - Two places, front side of both control boxes.

20



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Madison, Wisconsin	(608) 274-4866
Los Angeles, Calif.	(213) 722-5962

21399

21



**9200 S. SORENSEN AVE.
SANTA FE SPRINGS CALIF.**

CONDOR MODEL-_____ SERIAL NO-_____

ASSEMBLY NO-_____

PART NO-_____ DATE OF MFG-_____

MAXIMUM PLATFORM HEIGHT-_____

MAXIMUM HORIZONTAL REACH-_____

RATED LOAD RADIUS _____

HYDRAULIC OPERATING PRESSURE-_____ PSI

THIS UNIT IS NOT INSULATED

**THIS MOBILE UNIT CONFORMS TO ALL APPLICABLE
REQUIREMENTS OF ANSI A92.5 1980**

15843

FIGURE 2 - CARRIAGE WELDMENT (ALL MODELS)

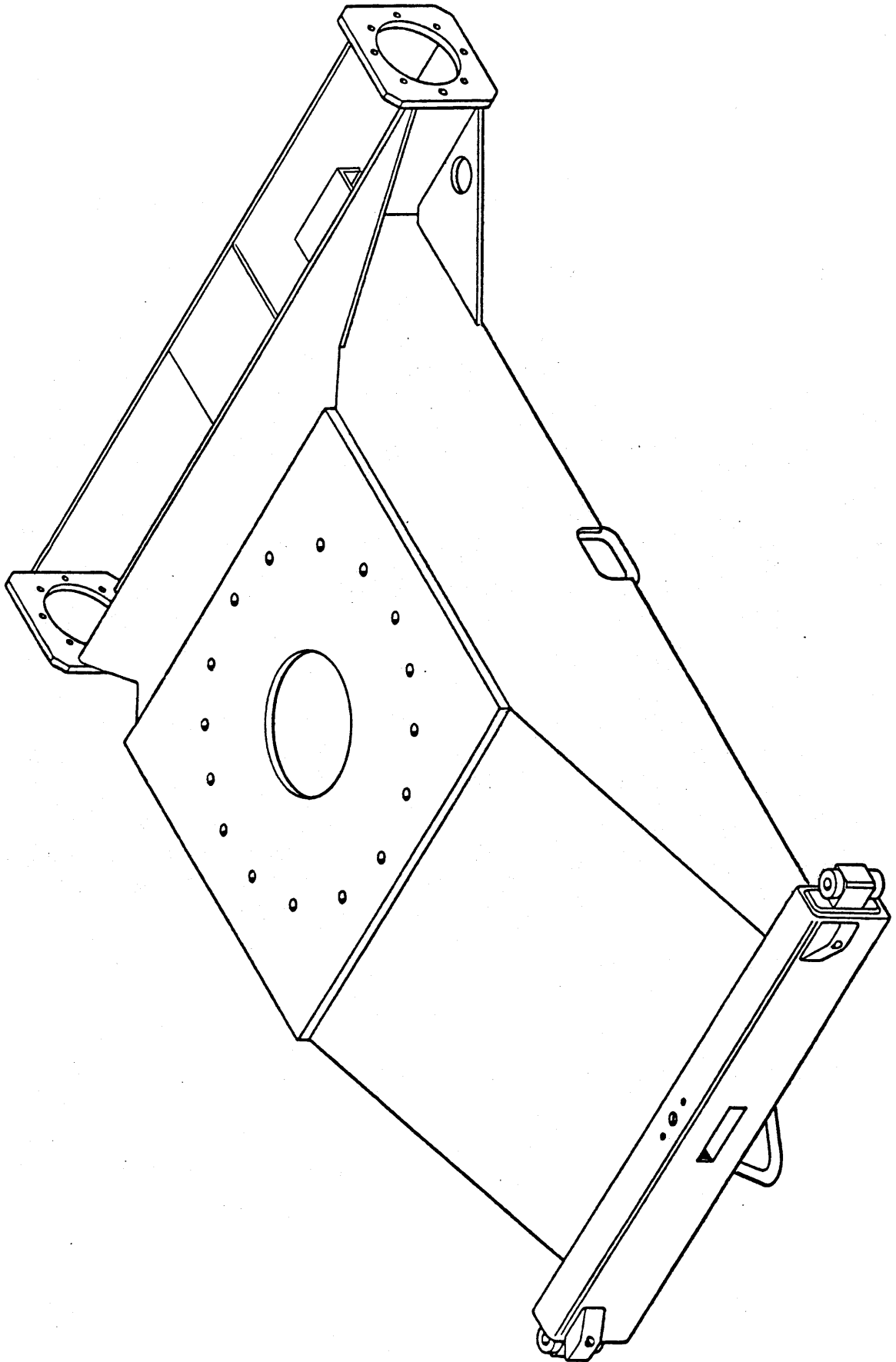


FIGURE 2 - CARRIAGE WELDMENT (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
2-	Carriage Weldment	50 - 21632 58 - 40831 68 - 40831 48 - 40778	1 1 1 1

FIGURE 3 - CARRIAGE ASSEMBLY (48, 50, 58, 68)

REF	DESCRIPTION	PART NUMBER	QTY
	NOTE: Unless otherwise stated, parts are common		
3-	Carriage Assembly	68075 (58) (68)	1
		40060 (50)	1
			1
	Carriage Hydraulic Hose & Fitting Assembly	40779 (48)	
		40022	1
- 1	Torque Drive Assembly	(See Fig. 4)	1
- 2	Wheel Assembly	(See Fig. 6)	1
- 3	Adapter	202702-4-4	2
- 4	Hose Assembly-Case Drain	6 CIT-6FJX-6JX-60	1
- 5	Adapter	2021-4-6	1
- 6	Adapter	202702-12-12	2
- 7	Hose Assembly	D7-EA04NJ- X 04NJ-72	2
- 8	90° Elbow	2024-4-4	2
- 9	Hex Head Capscrew	5/8-11UNC X 1-1/2 Grade 8	1
-10	Hose Assembly	H1-EC12-12NJX-90T-27	2
-11	Adapter	2027-12-12	2
-12	Tube Assembly	21799-22	1
-13	Tube Assembly	21799-23	1
-14	Adapter	2021-12-12	1
-15	Rotary Coupling Bracket	21627	1
-16	Hex Head Capscrew	3/8-16 UNC-7/8	2
-17	Lockwasher	3/8	2
-18	Rotary Coupling (See Fig. 9)	32554	1
-19	Hex Head Capscrew	(1/2-13 UNC x 1-3/4)	18
-20	Ring Gear	21770 (50, 58, 68)	1
		21922 (48)	1
-21	Hex Locknut	36786 (5/8-11 UNC)	15
-22	Hex Head Capscrew	36149 (5/8-11 UNC X 2)	15
-23	Hex Head Capscrew	5/16-18 UNF X 1-3/4	4
-24	Lockwasher	5/16	4
-25	Turret Weld.	Ref.	1
-26	Hex Nut	5/16-18 UNF	4
-27	Hub, Spindle/Knuckle and Stub	(See Fig. 5) 50, 58, 68	1
-28	Axle Assembly, Steering Assembly	(See Fig. 5A) 48	1
-29	Hose Assembly (See Fig. II)	Ref.	1
-30	Hose Assembly- Wheel Drive Valve Assembly	Ref.	1
-31	Lockwasher	5/8	1
-32	Lockwasher	5/8 Dia. - Nordic	18

FIGURE 3C FOUR WHEEL DRIVE OPTION

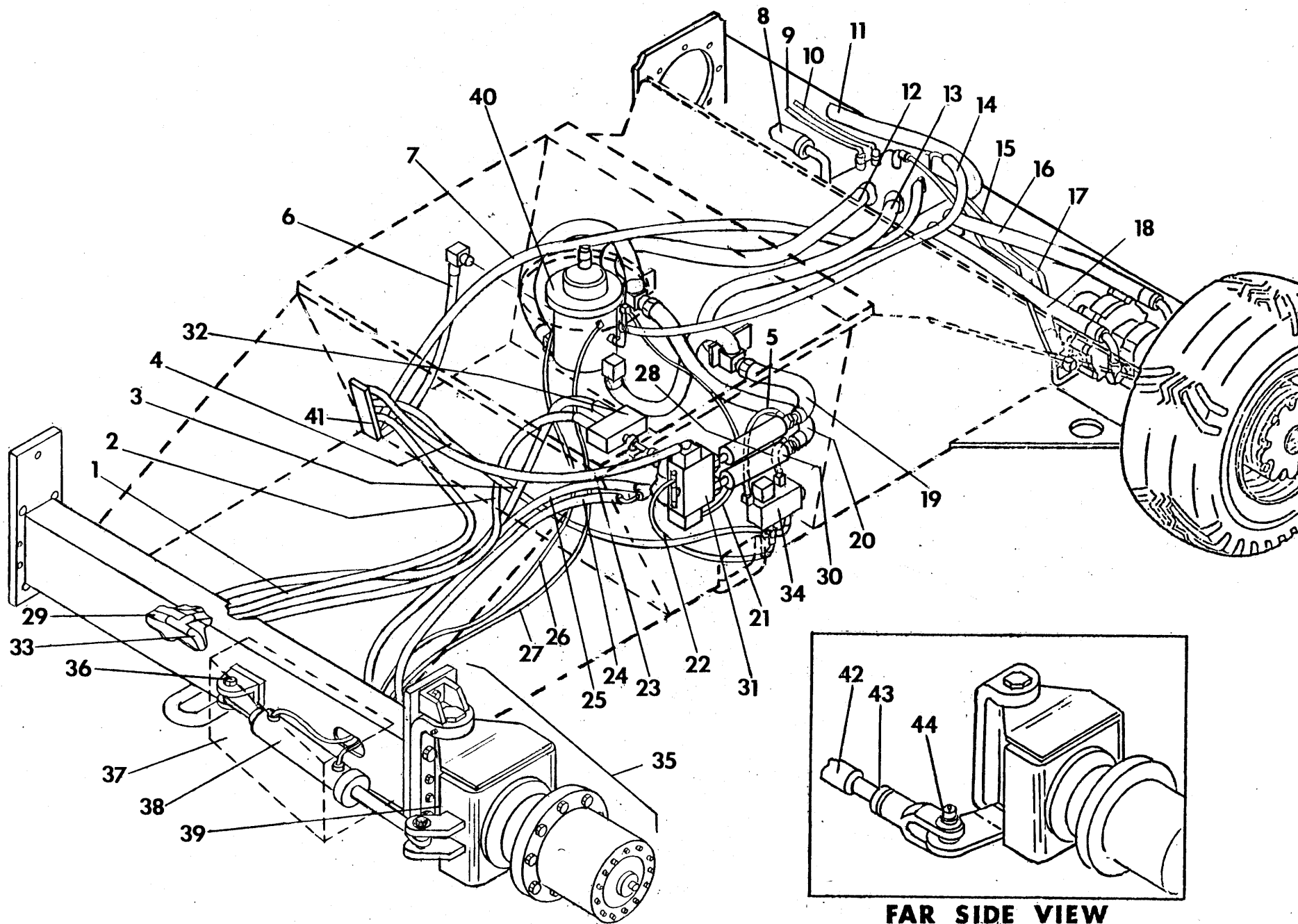


FIGURE 3C FOUR WHEEL DRIVE OPTION (ON 6066 BASE)

REF	DESCRIPTION	PART NUMBER		QTY
1	Hose Assembly, 51" LG	J406-06NJ	J406-06NJ	1
2	Hose Assembly, 91" LG	J408-08NJ	J408-08NJ	1
3	Hose Assembly, 91" LG	J408-08NJ	J408-08NJ	1
4	Hose Assembly, 44" LG	J404-04NJ	J404-04NJ	1
5	Hose Assembly, 15" LG	J404-04NJ	J404-04NJ	1
6	Hose Assembly, 22" LG	J406-06NJ	J406-06NJ	1
7	Hose Assembly, 98" LG	J406-06NJ	J406-06NJ	1
8	Hose Assembly, 17" LG	HA12-12NJ	HA12-12NJ	1
9	Tubing			1
10	Tubing			1
11	Hose Assembly, 27" LG	HA12-12NJ	HA12-12NJ 90°T	1
12	Hose Assembly, 71" LG	HA12-12NJ	HA12-12NJ	1
13	Hose Assembly, 71" LG	HA12-12NJ	HA12-12NJ	1
14	Hose Assembly, 99" LG	J406-06NJ	J406-06NJ 90°TL	1
15	Tubing			1
16	Hose Assembly, 36" LG	HA12-12NJ	HA12-12NJ 90°T	1
17	Tubing			1
18	Hose Assembly, 36" LG	HA12-12NJ	HA12-12NJ 90°T	1
19	Hose Assembly, 35" LG	J408-08NJ	J408-08NJ	1
20	Hose Assembly, 26" LG	J408-08NJ	J408-08NJ	1
21	Hose Assembly, 34" LG	J404-04NJ	J404-04NJ	1
22	Hose Assembly, 26" LG	J404-04NJ	J404-04NJ	1
23	Hose Assembly, 64" LG	J401-04NJ	J401-04NJ	1
24	Hose Assembly, 91" LG	J408-08NJ	J408-08NJ	1
25	Hose Assembly, 91" LG	J408-08NJ	J408-08NJ	1
26	Hose Assembly, 88" LG	J404-04NJ	J404-04NJ	1
27	Hose Assembly, 88" LG	J404-04NJ	J404-04NJ	1
28	Hose Assembly, 15" LG	J404-04NJ	J404-04NJ	1
29	Hose Assembly, 32" LG	J406-06NJ	J406-06NJ	1
30	Flow Control Valves (set at 4 GPM)	PC5-4-4		2
31	Selector Valve (for Mudhog)	101318-CPP		1
32	Flow Divider	2VI3-41-3-65		1
33	Hose Assembly, 32" LG	J406-06NJ	J406-06NJ	1
34	Pressure Reducing Valve	1PD11-FZ-6 S		1
35	Mudhog Assembly	40588		2
36	Pins, 1" x 3" LG Cap Screw	36517		2
37	Cover	40576		1
38	Steering Cylinder	32545		1
39	2 Cubic Inch Drive Motor	40583		2
40	6 Port Manifold	21562		1
41	Collector Block	6400-0 str 6-6		1
42	Tie Rod	40570		1
43	End Bearing	40589		2
44	Pins, 3/4" x 3 1/2" LG Cap Screw	36178		2

FIGURE 3C-I FOUR WHEEL DRIVE

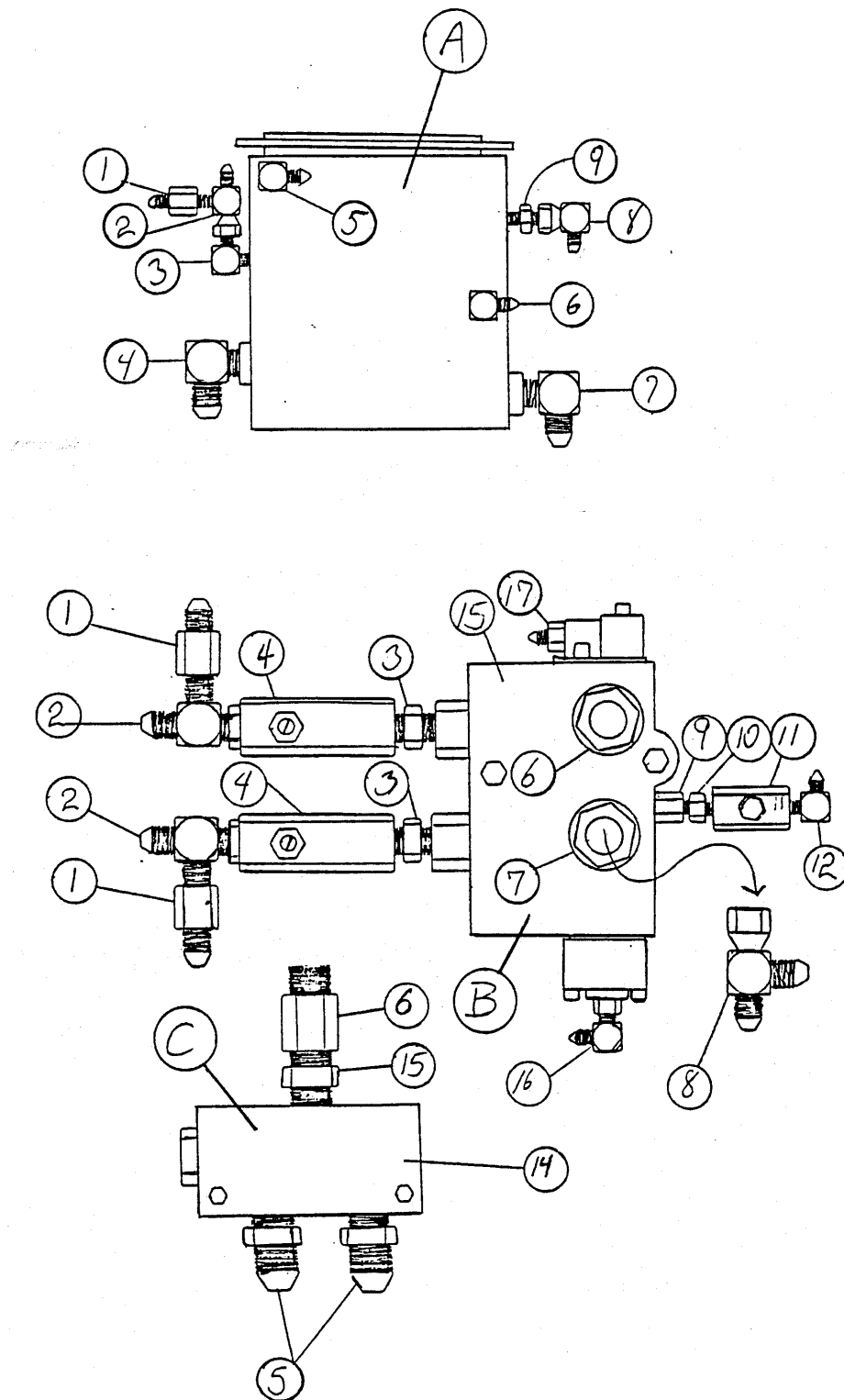


FIGURE 3C-1 FOUR WHEEL DRIVE

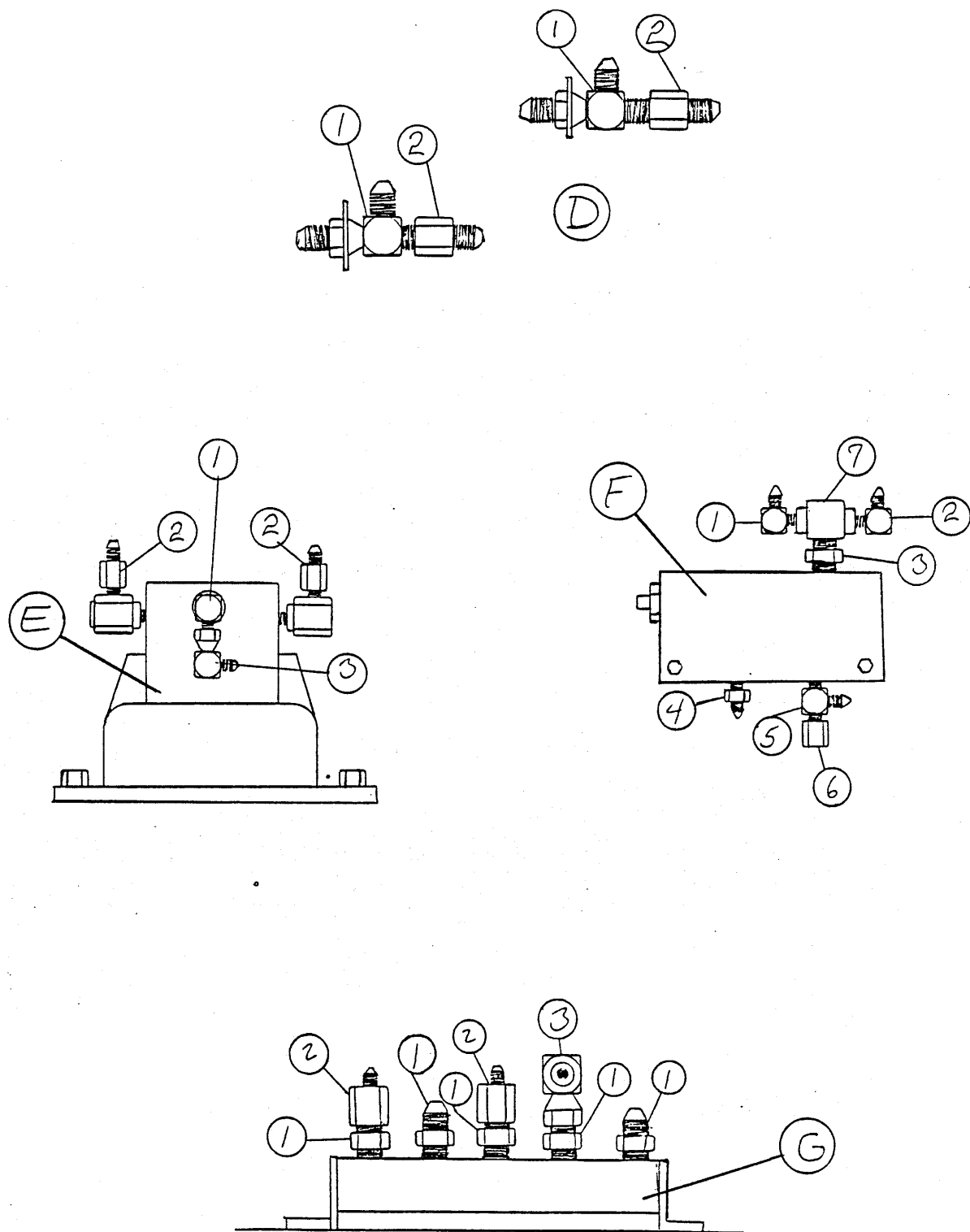


FIGURE 3C - I FOUR WHEEL DRIVE

<p>A 7 Port Manifold (32554)</p> <p>1 — 2406-STR 6-4/reducer</p> <p>2 — 6602-Tee 6-6</p> <p>3 — 2501 - 90° 6-4</p> <p>4 — 6801 - NWD 90° 12-12</p> <p>5 — 6801 - NWD 90° 4-4</p> <p>6 — 6801 - NWD 90° 4-4</p> <p>7 — 6801 - NWD 90° 12-12</p> <p>8 — 6500 - 90° 6-6</p> <p>9 — 2404 - STR 6-4</p> <p>B Selector Valve</p> <p>C Flow Divider</p> <p>1 — 2406 - STR 8-4/reducer</p> <p>2 — 2506 - Tee 8-8 or 6804 NWD - Tee 8-8</p> <p>3 — 5404 - STR 8-8</p> <p>4 — Flow Control Valve PCS - 4 - 4</p> <p>5 — 2404 - STR 8-6</p> <p>6 — 6405 - 0 - STR 8-8</p> <p>7 — 6400 - 0 - STR 8-8</p> <p>8 — 6500 - 90° 8-8</p> <p>9 — 6405 - STR 4-4</p> <p>10 — 5404 - STR 4-4</p> <p>11 — Valve CP2013</p> <p>12 — 2501 - 90° 4-4</p> <p>13 — 5404 - STR 8-8</p> <p>14 — Flow Divider 2V13-4-3-6S</p> <p>15 — Selector Valve 101318-CPP</p> <p>16 — 6801 - NWD - 90° 4-4</p> <p>17 — 6400 - 0 - STR 4-4</p> <p>D Bulkhead Fittings</p> <p>1 — Bulkhead fittings 2704-LN 12-12</p> <p>2 — 2406 - STR 12-8/reducer</p> <p>E Mudhog Assembly (650145-CPP)</p> <p>1 — 6801 - NWD - 90° 6-6</p> <p>2 — 2406 - STR 12-8/reducer</p> <p>3 — 6500 - 90° 6-6</p> <p>F Pressure Reducing Valve (IPD11-EZ-6S)</p> <p>1 — 2501 - 90° 4-4</p> <p>2 — 2501 - 90± 4-4</p> <p>3 — 5404 - STR 4-4</p> <p>4 — 2404 - STR 4-4</p> <p>5 — 2605 - Tee 4-4</p> <p>6 — 304-6 Cap Nut # 4</p> <p>7 — CPZOB Shuttle Valve</p>	<p>G Collector Block</p> <p>1 — 2404 - 6-4</p> <p>2 — 2406 - STR 6-4/reducer</p> <p>3 — 6500 - 90 6-6</p> <p>Hyflex fittings</p>
--	---

FIGURE 3D FOUR WHEEL DRIVE STEERING ASSEMBLY (40588)

REF	DESCRIPTION	PART NUMBER	QTY
1	C-Frame Assembly	500272-M1	1
2	Pivot Pin	101302-M1	2
3	Spherical Bearing	101119-P1	2
4	Grease Fitting	101127-P1	2
5	Spacer	101298-M1	1
6	Thrust Washer	101332-P1	2
7	Thrust Washer - Nylatron	101301-P1	1
8	1 5/8 Jam Nut	100901-M1	2
9	90° Elbow (High Pressure Swivel)	200071-P1	2
10	90° Elbow (08 ORB-M X 06 JIC-M)	200078-P1	1
11	Plug (08 ORB-M)	208000-P1	1
12	Box Frame Assembly	500273-M1	1
13	5/8 X 2 UNC Gr. 8 Hex Head Bolt	100275-P1	2
14	5/8 Jam Nut	100276-P1	2
15	Planetary Gear Box	100871-P1	1
16	5/8 Flat Washer	100073-P1	6
17	5/8 X 1 1/2 UNC Gr. 8 Hex Head Bolt	100075-P1	6
18	5/8 UNF Wheel Lug Nut	100321-P1	9

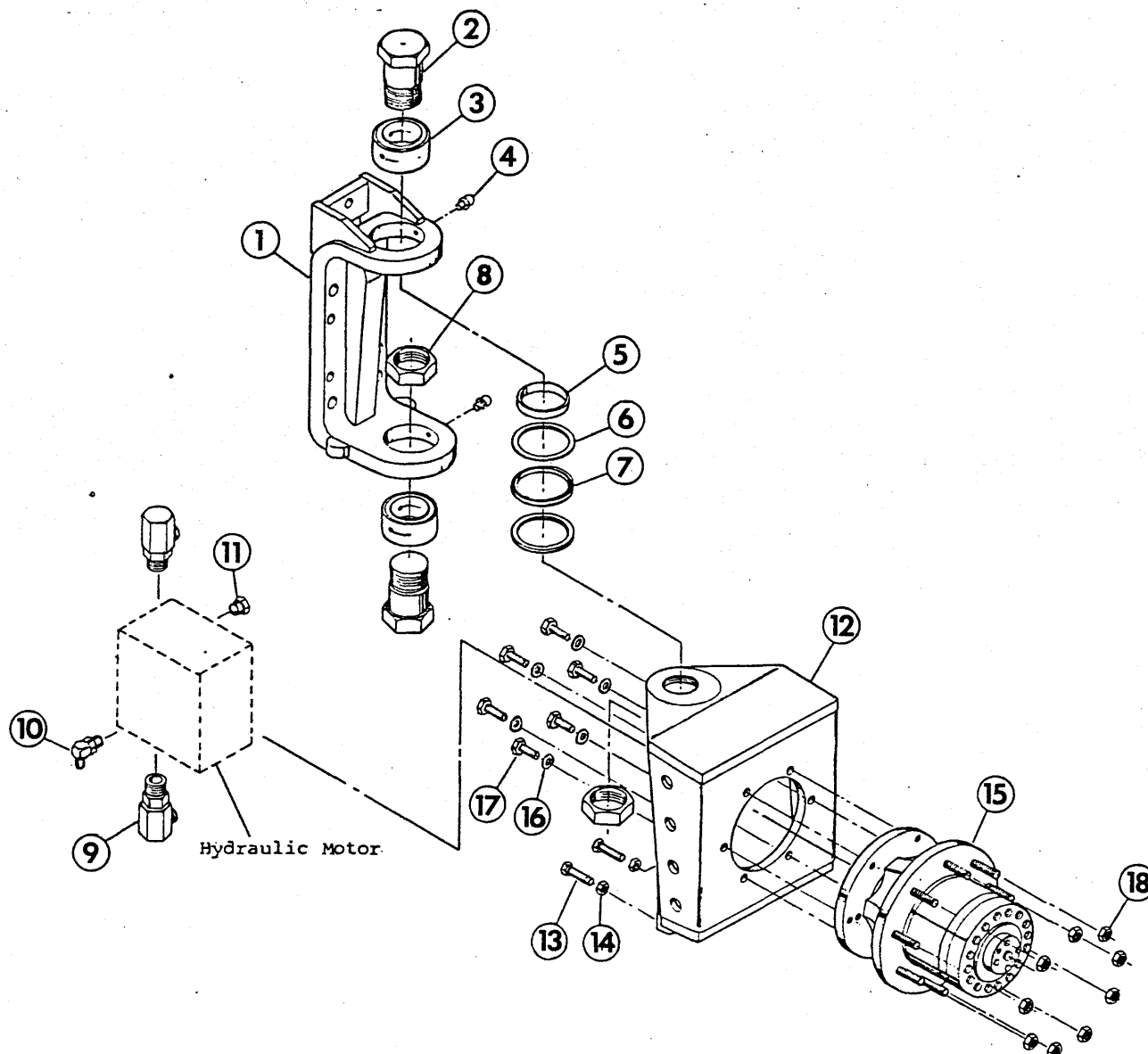


FIGURE 4 TORQUE DRIVE ASSEMBLY (ALL MODELS)

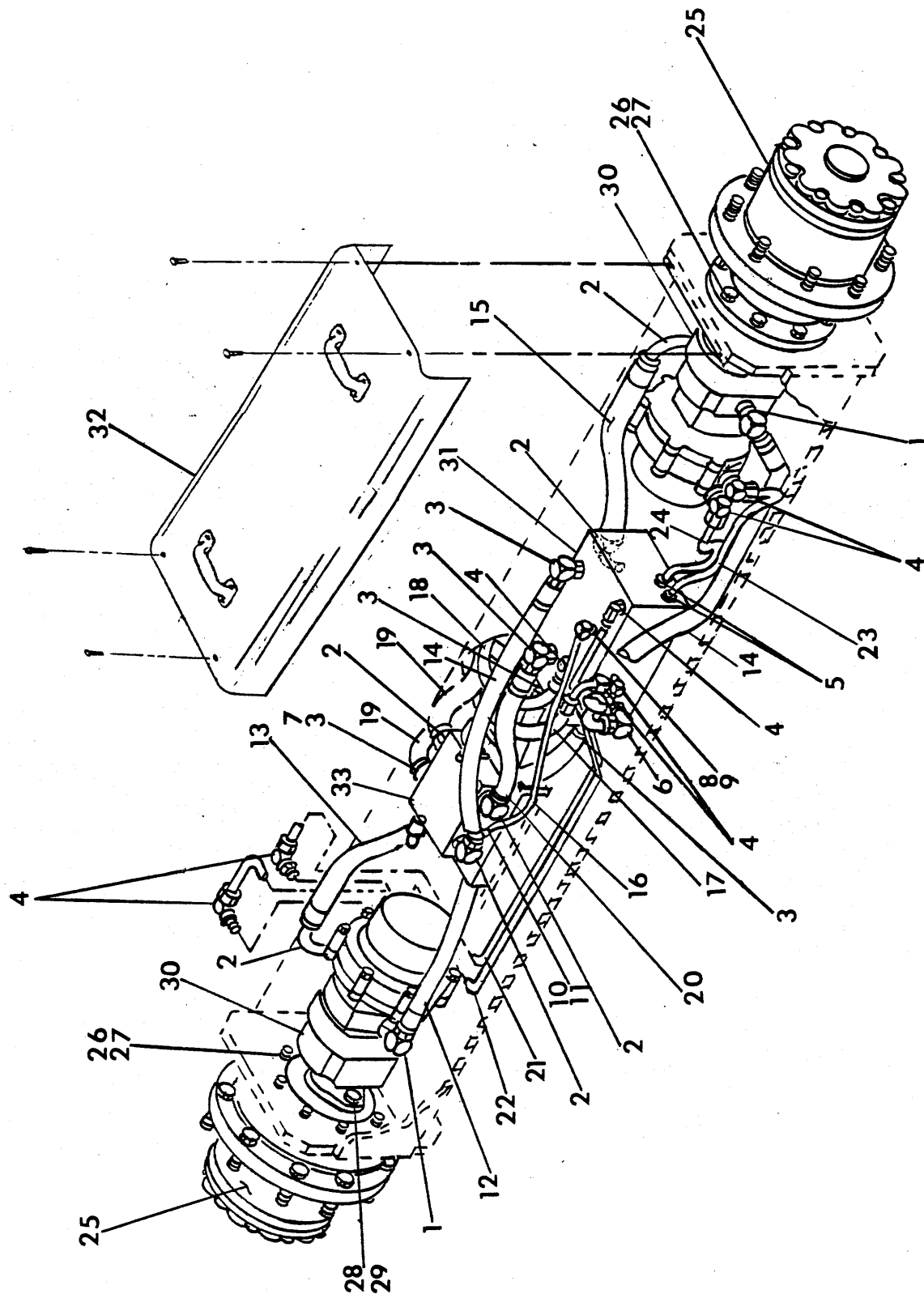


FIGURE 4 TORQUE DRIVE ASSEMBLY (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
1	O-Ring Elbow 90°	6801-LL-12-NW0	2
2	O-Ring Elbow 90°	6801-12-12	6
3	Straight	6400-12-12	5
4	O-Ring Elbow 90°	6801-6-6NW0	8
5	O-Ring Adapter	6400-6-6	2
6	O-Ring Elbow 90°	6801-L-12-NW0	1
7	Elbow 90° Swivel	6500-12-12	1
8	O-Ring Male-Female Pipe Coupling	6405-6-4	1
9	Elbow 90° JIC-Pipe	2501-4-4	1
10	Straight Connector O-Ring-JIC	6400-6-4	1
11	Elbow 90° Male Tube-Female 37° Swivel	6500-4-4	1
12	Hose Assembly	9812-1818-0360	1
13	Hose Assembly	9812-1890-0360	1
14	Hose Assembly	9812-1890-0270	2
15	Hose Assembly	9812-1890-0190	1
16	Hose Assembly	9804-1818-0230	1
17	Hose Assembly	9806-1891-0980	1
18	Hose Assembly	9806-1818-0890	1
19	Hose Assembly	9812-1818-0710	2
20	Hose Assembly	9812-1890-0180	1
21	Tube Assembly	40183	1
22	Tube Assembly	40186	1
23	Tube Assembly	40185	1
24	Tube Assembly	40184	1
25	Torque Drive Hub	21486 (50)	2
		21458 (48)	2
		21492 (58, 68)	2
26	Hex HD. Capscrew	5/8-11UNC x 1-3/4	12
27	Lockwasher Nordic	5/8	12
28	Hex HD. Capscrew	1/2-13UNC x 1-14	4
29	Lockwasher	1/2	4
30	Hyd. Motor With Disc Brake	21568	2
31	Wheel Drive Valve Assembly	40099	1
32	Carriage Cover	40168	2
33	Brake Valve	32613	1

FIGURE 4A WHEEL DRIVE VALVE ASSEMBLY

REF	DESCRIPTION	PART NUMBER	QTY
1	Modular Valve Assembly	40099	1
2	Plug	92066	1
2	Diverter Valve	92067	2
3	W/SAE 6 Port	92068	1
4	Flow Control Valve, (Cartridge)	92069	1
5	Flow Divider, (Cartridge)	92070	1
6	Manifold	92071	1

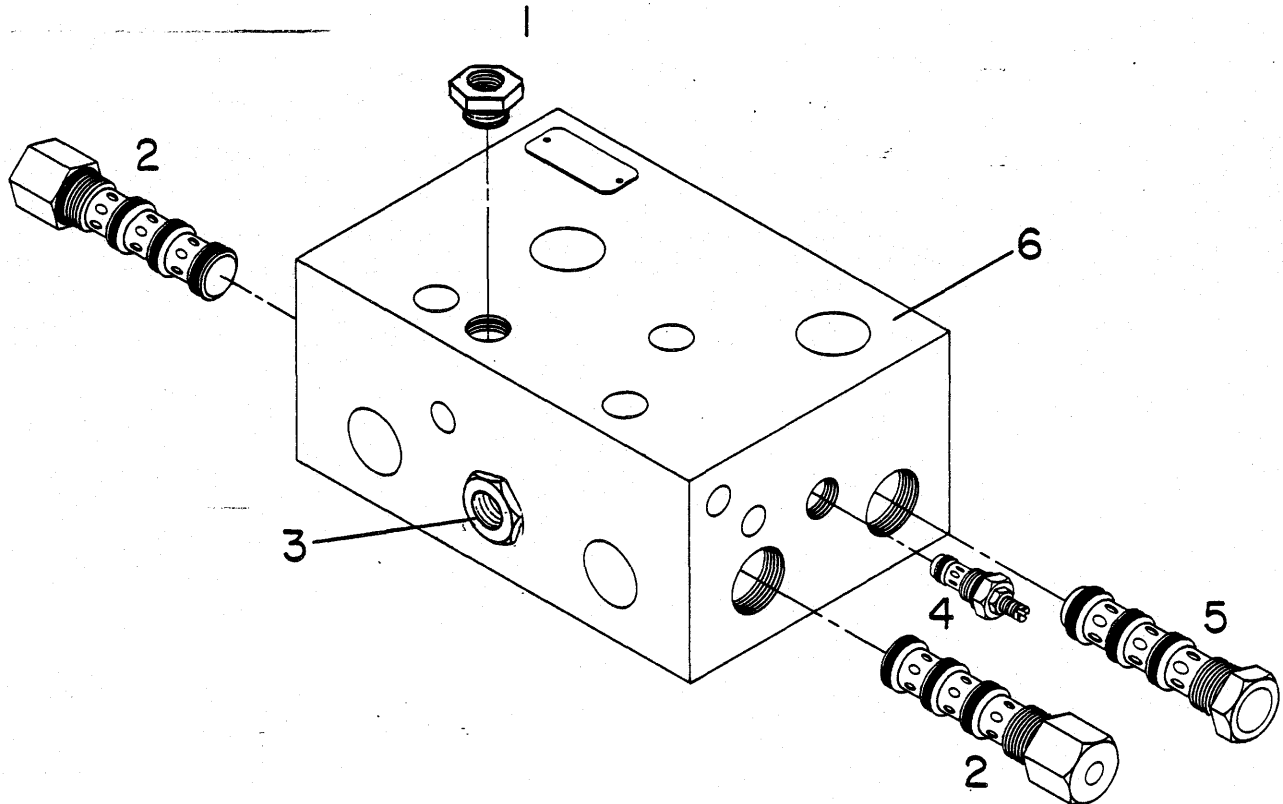
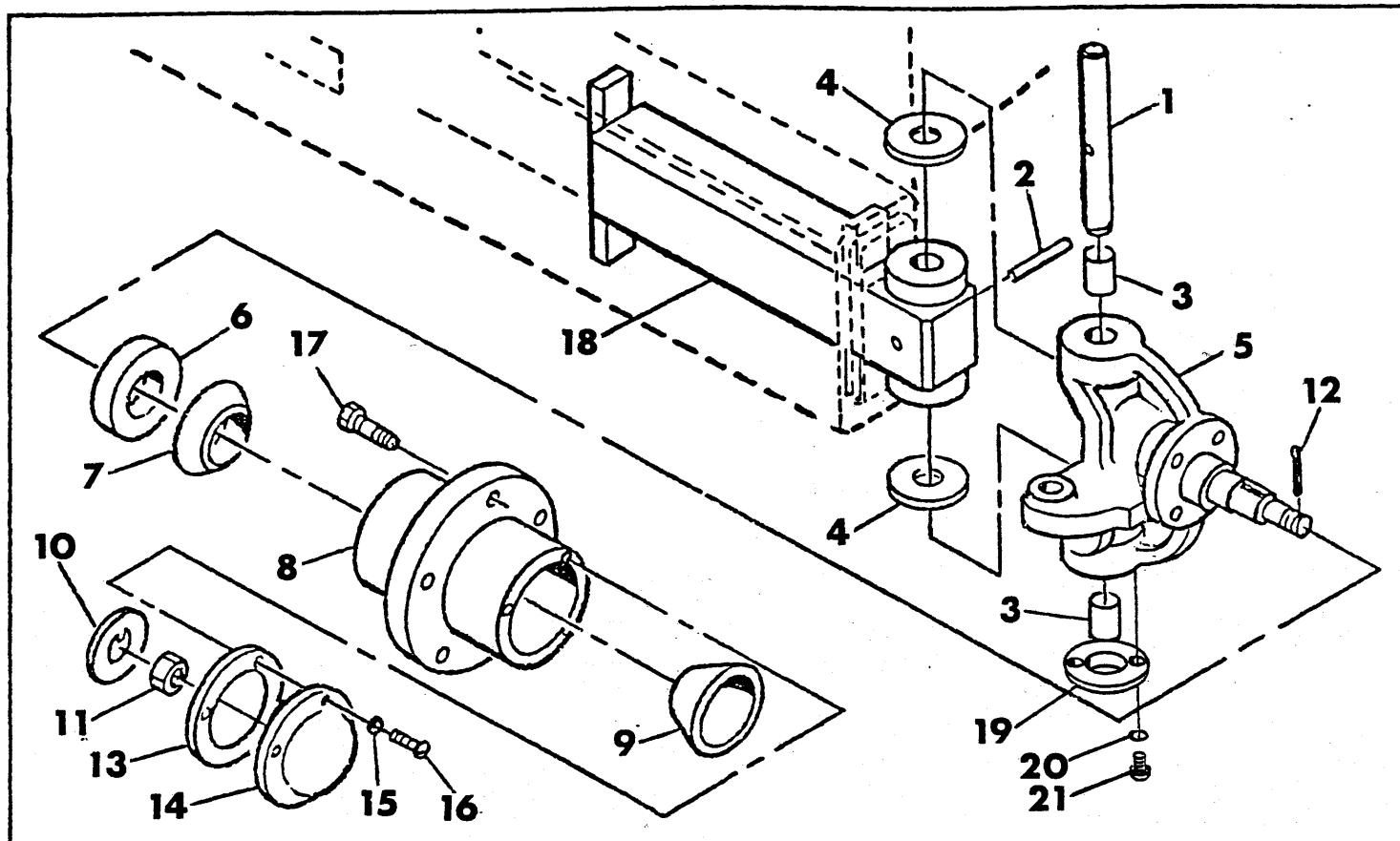


FIGURE 5 - HUB, SPINDLE KNUCKLE AND STUB AXLE ASSEMBLY
(50, 58, 68)

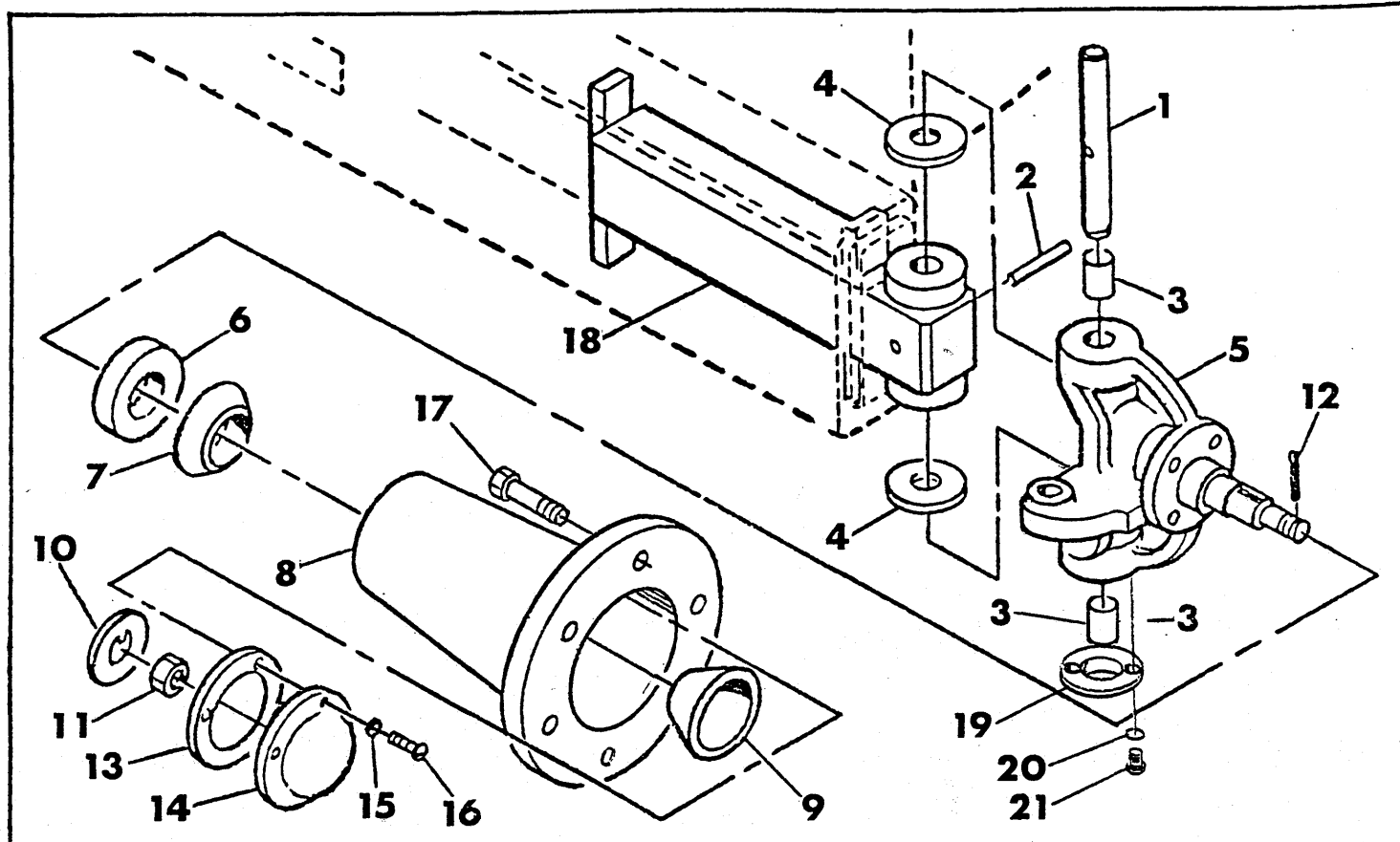


REF.	DESCRIPTION	PART NUMBER	QTY.
5-	Hub, Spindle/Knuckle and Stub Axle Assy.	Part of 21485 ((50)	1
		Part of 21485 (58)	1
		Part of 21485 (68)	1
- 1	King Pin	" 5	2
- 2	Roll Pin	" 22	2
- 3	Bushing	" 2 or 3	4
- 4	Thrust Washer	" 13	4
- 5	Spindle/Knuckle	" 2-LH-3RH	1
- 6	Grease Seal	" 11	2
- 7	Inner Cone	" 9	2
- 8	Hub	" 4	2
- 9	Outer Cone	" 8	2
-10	Key Washer	" 23	2
-11	Spindle Nut	" 24	2
-12	Cotter Pin	" 25	2
-13	Gasket	" 14	2
-14	Grease Cap	" 12	2
-15	Washer	" 18	6
-16	Hex Head Screw	" 16	6
-17	Stud	" 21	12
-18	Stub Axle Weldment	" 1	2
Note: Above items are part of Kit No. 21485			

FIGURE 5 - HUB, SPINDLE, KNUCKLE AND STUB AXLE ASSEMBLY
(50, 58, 68)

REF	DESCRIPTION	PART NUMBER	QTY
-19	End Cover	Part of 21485 6	4
-20	Lockwasher	No. 10	8
-21	Hex Head Capscrew	No. 10-24UNC X .50	8

FIGURE 5A - HUB, SPINDLE KNUCKLE AND STUB AXLE ASSEMBLY (48)

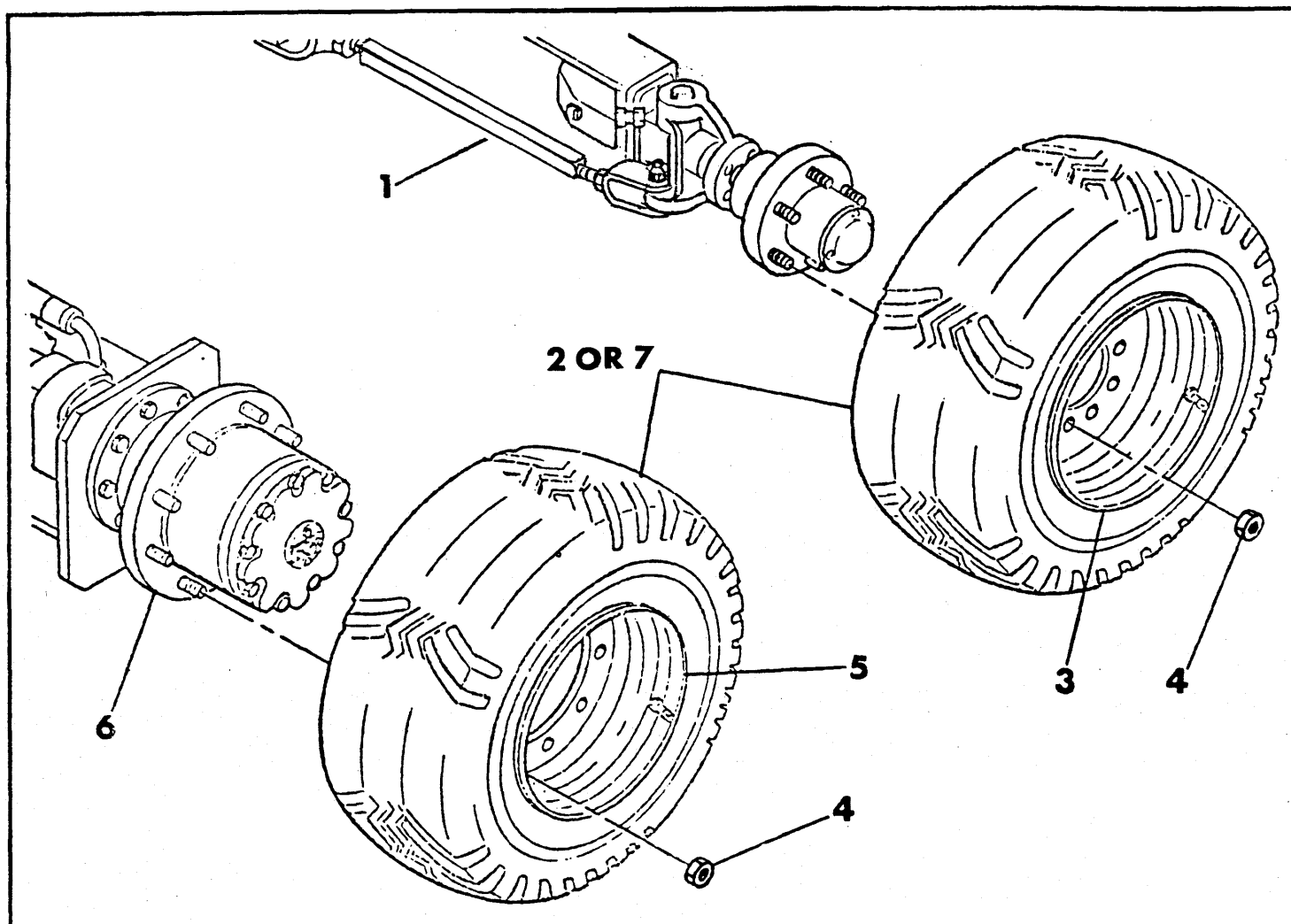


REF	DESCRIPTION	PART NUMBER	QTY
5A-	Hub, Spindle/Knuckle and Stub Axle Assy.	Part of 21456	1
- 1	King Pin	" 5	2
- 2	Roll Pin	" 22	2
- 3	Bushing	" 2 or 3	4
- 4	Thrust Washer	" 13	4
- 5	Spindle/Knuckle	" 2LH-3RH	1
- 6	Grease Seal	" 11	2
- 7	Inner Cone	" 10	2
- 8	Hub	" 4	2
- 9	Outer Cone	" 8	2
-10	Key Washer	" 27	2
-11	Spindle Nut	" 28	2
-12	Cotter Pin	" 23	2
-13	Gasket	" 14	2
-14	Grease Cap	" 12	2
-15	Washer	" 21	8
-16	Hex Head Screw	" 19	8
-17	Stud	" 16	12
-18	Stub Axle Weldment	" 1	2
Note: Above items are part of Kit No. 21456.			

FIGURE 5A - HUB, SPINDLE KNUCKLE AND STUB AXLE ASSEMBLY (48)

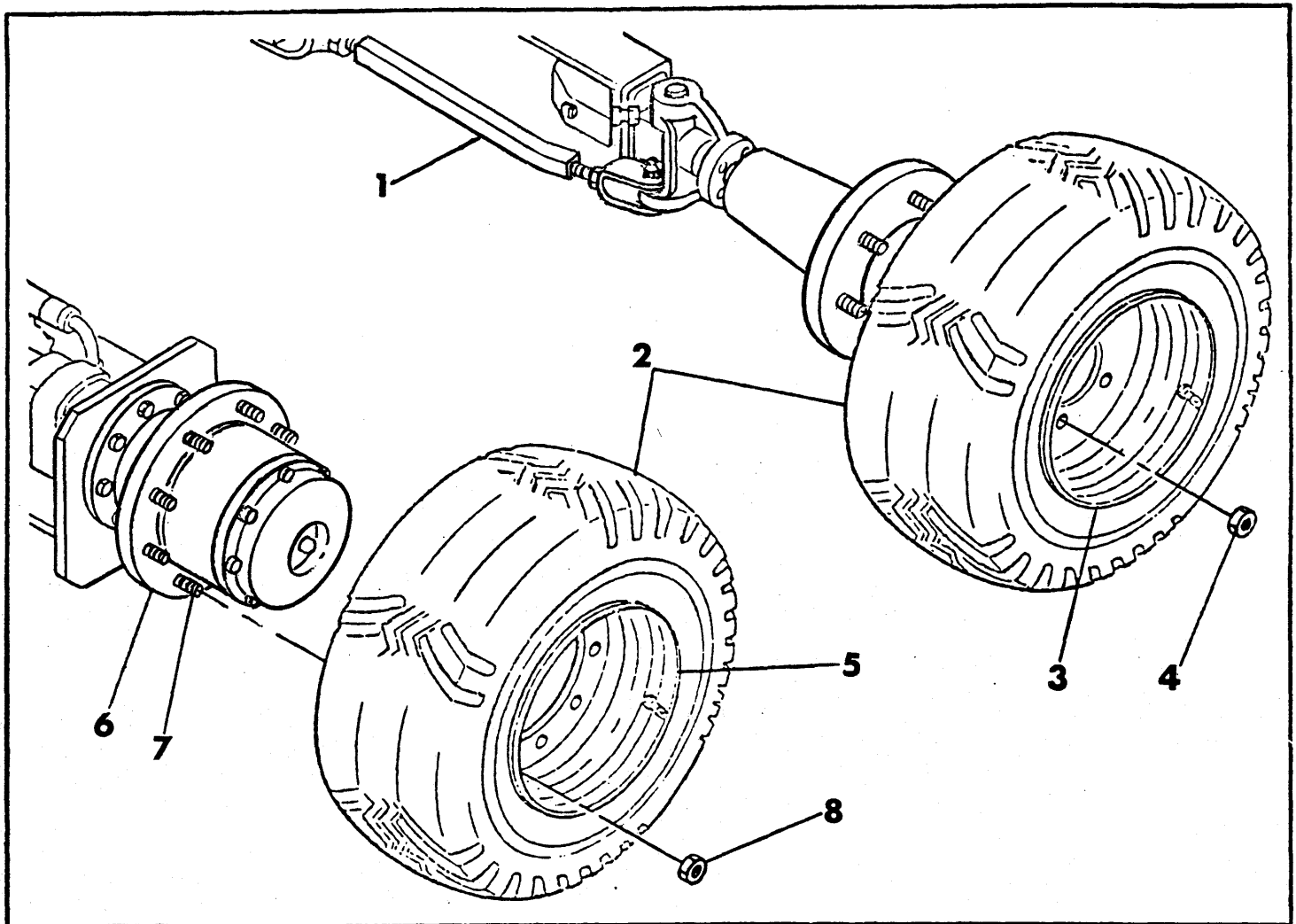
REF	DESCRIPTION	PART NUMBER	QTY
-19	End Cover	6	4
-20	Lockwasher	No. 10 20	8
-21	Hex Head Capscrew	No. 10 -24UNC X 18	8

FIGURE 6 - TIRE-WHEEL ASSEMBLY (50, 58, 68)



REF.	DESCRIPTION	PART NUMBER	QTY.
6-	Tire-Wheel Assy. (Front)	21339 (50)	2
	Tire-Wheel Assy. (Rear)	21989 (58, 68)	2
		21338 (50)	2
		21983 (58, 68)	2
- 1	Steering Assy.	See Fig. 7	1
- 2	10-Ply Super All Traction Hi-Flotation Tire	21487 (50)	4
		21494 (58, 68)	4
- 3	Wheel Assy. (Front)	21948 (50)	2
		21952 (58, 68)	2
- 4	Wheel Nut	30288	32
- 5	Wheel Assy. (Rear)	21734 (50)	2
		21950 (58, 68)	2
- 6	Torque Drive Assembly	See Fig. 4	1
NOTE: Unless otherwise stated, parts are common for 50, 58, 68			

FIGURE 6A - TIRE-WHEEL ASSEMBLY (48)



REF.	DESCRIPTION	PART NUMBER	QTY.
6A-	Tire-Wheel Assy. (Front)	21497	2
	Tire-Wheel Assy. (Rear)	21496	2
- 1	Steering Assembly	See Fig. 7	1
- 2	8-Ply Super All-Traction Hi-Flotation Tire 12.00 X 16.5	21459	4
- 3	Wheel Assy. (Front)	21947	2
- 4	Wheel Nut, $\frac{1}{2}$ "-20 UNC		18
- 5	Wheel Assy. (Rear)	21949	2
- 6	Torque Drive Assy.	See Fig. 4	1
- 7	Stud	14-00-183-005	16
- 8	Wheel Nut	9/16-18UNF	16

FIGURE 7 - STEERING ASSEMBLY (ALL MODELS)

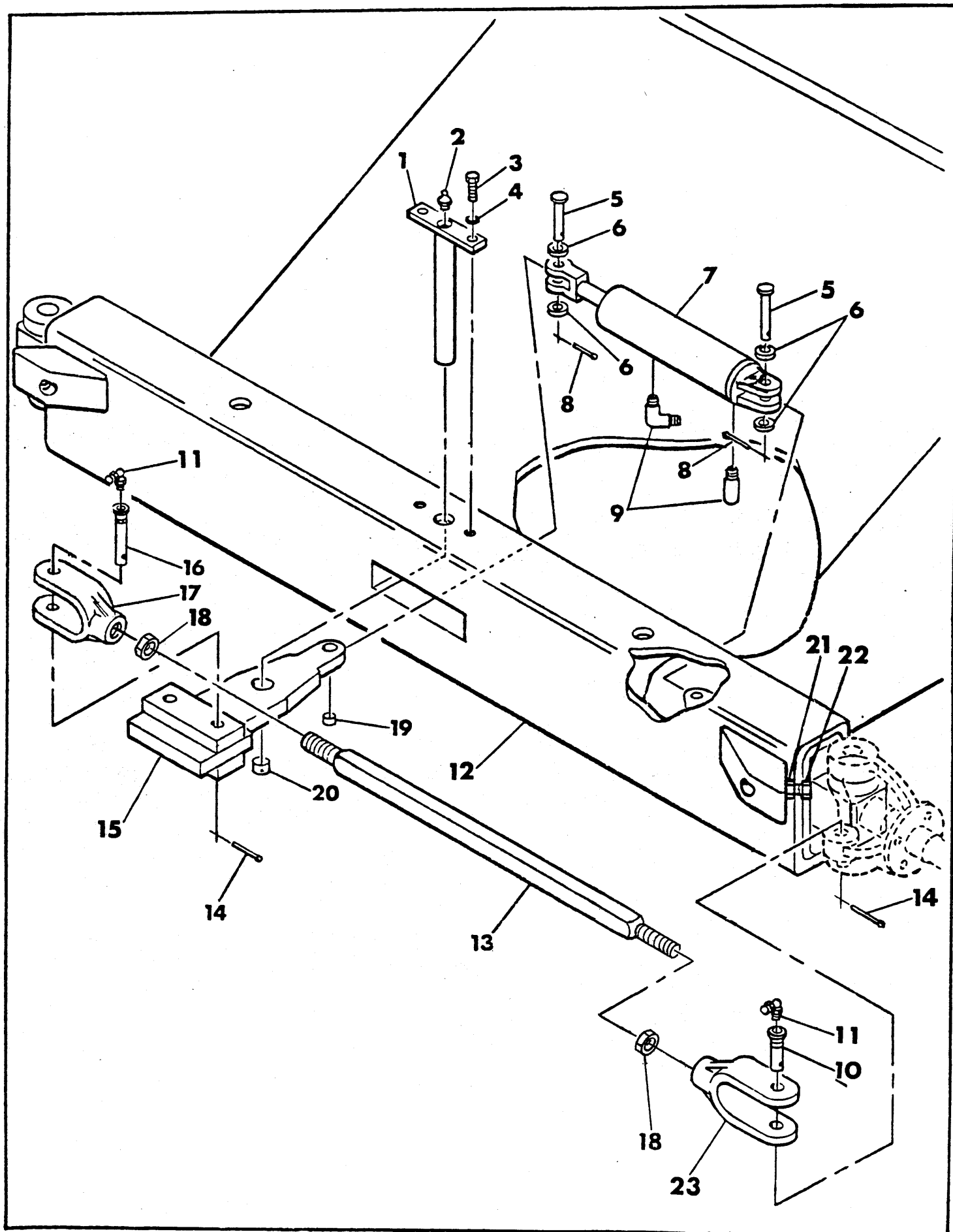
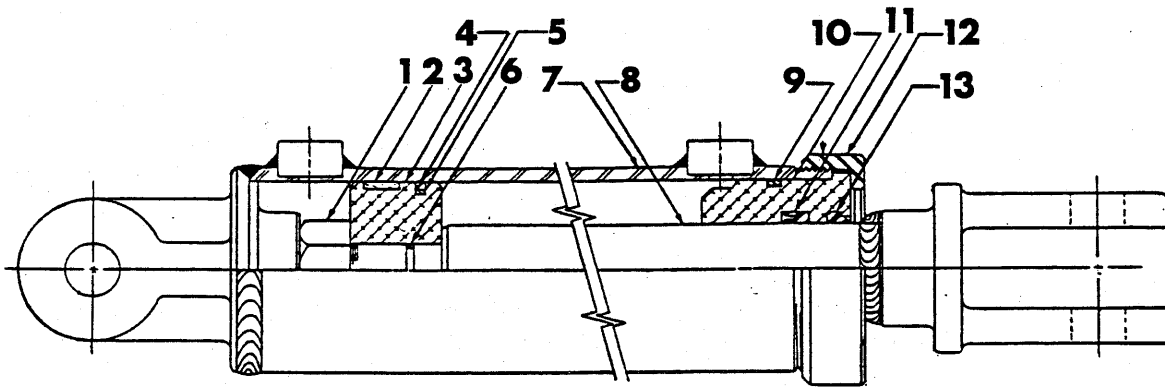


FIGURE 7 - STEERING ASSEMBLY (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
7-	Steering Assembly	Part of 21485 (50)	1
		Part of 21485 (48)	1
		Part of 21485 (58)	1
		Part of 21485 (68)	1
- 1	Steering Center Arm Pin	21136	1
- 2	Lube Fitting	1610BL	1
- 3	Hex Head Capscrew	3/8-16UNC X 3/4	2
- 4	Lockwasher	3/8	2
- 5	Clevis Pin	C-46	2
- 6	Washer	3/4	4
- 7	Steering Cylinder (See Figure 8)	40002	1
- 8	Cotter Pin	1/8 X 2	2
- 9	Elbow	2024-4-4	2
-10	Yoke Pin*	" 33	2
-11	Lube Fitting*	" 32	4
-12	Carriage Weldment	(See Fig. 2)	1
-13	Tie Rod*	" 26	2
-14	Nut and Cotter Pin	" 36 & 37	4
-15	Steering Center Arm Weldment	21148	1
-16	Yoke Pin*	" 34	2
-17	Yoke*	" 28	2
-18	Jam Nut*	" 31	4
-19	Bushing	M1218-8	1
-20	Bushing	21148-5	1
-21	Hex Nut	3/4-10 UNC	2
-22	Hex Head Capscrew	3/4-10 UNC X 2- $\frac{1}{4}$	2
-23	Yoke*	" 27	2
* These items are part of Kit No. 21485 (The dash numbers are listed in Steering Assembly Drawings)			

FIGURE 8 - STEERING CYLINDER (ALL MODELS)



REF	DESCRIPTION	PART NUMBER	QTY
8-	Steering Cylinder (L)	40002	1
1	Locknut - Self-Locking	92027	1
2	Wear Ring	*	1
3	Piston	92037	1
4	Piston Seal	*	1
5	O-Ring	*	1
6	Rod Static Seal	*	1
7	Barrel Assembly	92038	1
8	Rod Assembly	92039	1
9	Gland Static Seal	*	1
10	Gland	92035	1
11	Rod Seal	*	1
12	Collar	92036	1
13	Rod Wiper	*	1
14 *	Seal Kit (Contains Items 2,4,5,6,9,11,13)	92040	1

FIGURE 9 ROTARY COUPLING (ALL MODELS)

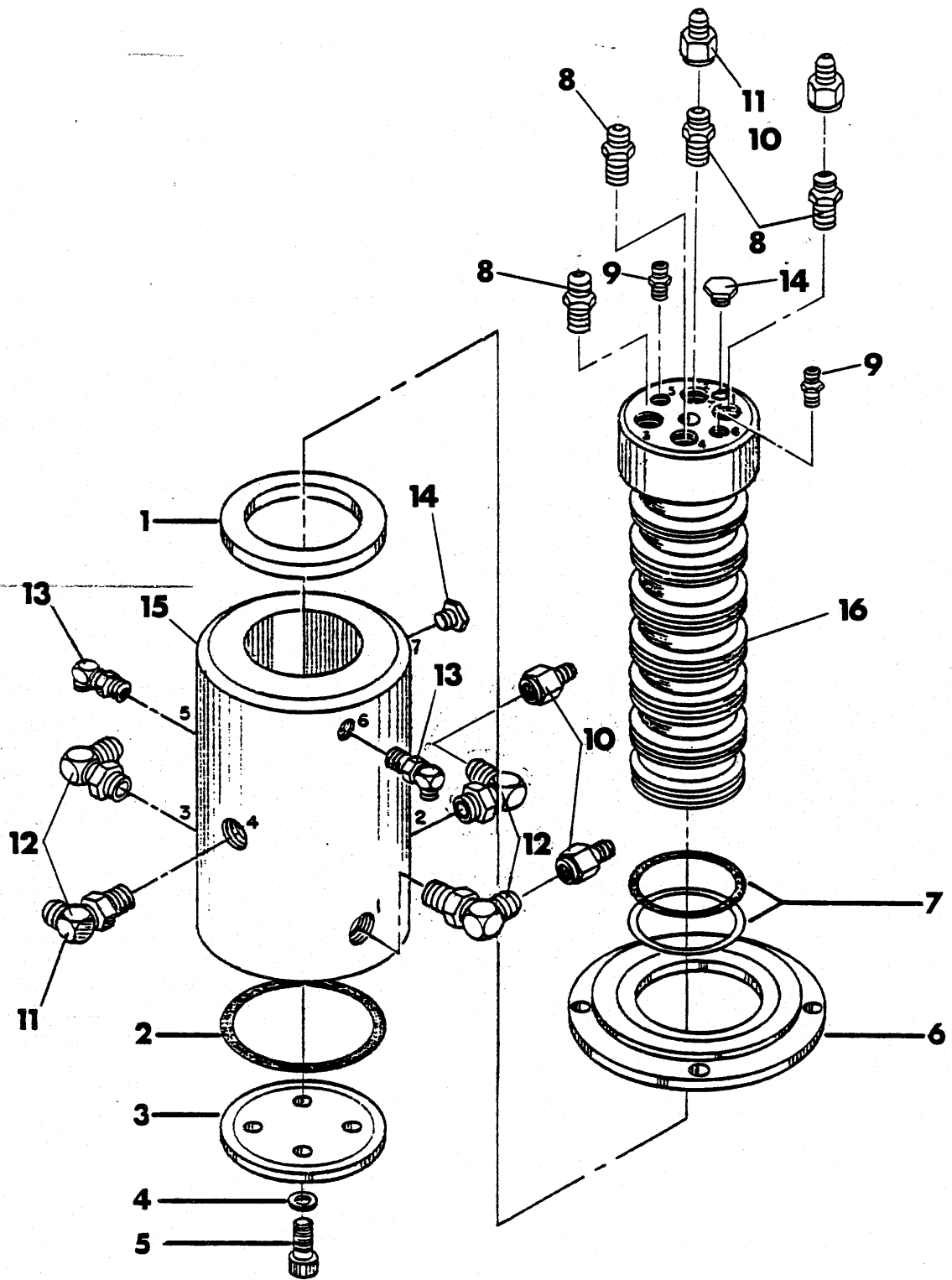


FIGURE 9 ROTARY COUPLING (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
	Rotary Coupling (7 Port Manifold)	32554	
1	Spacer	92072	1
2	O-Ring	*	1
3	Keeper Plate	92073	1
4	Lockwasher	92074	4
5	Capscrew, Socket Head	92075	4
6	Mounting Plate	92076	1
7	Seal Set	*	8
8	STR	6400-12-12	4
9	STR	6400-4-4	2
10	Tube Reducer	2406-12-4	3
11	Tube Reducer	2406-12-6	1
12	O-Ring Elbow 90°	6801-NWO-12-12	4
13	O-Ring Elbow 90°	6801-NWO-4-4	2
14	O-Ring Boss Plug	6408-4	2
15	Housing	92077	1
16	Spool	92078	1
17*	Seal Kit (Contains eight of Item 7 and, one of Item 2)	92079	

FIGURE 10 - TURRET ASSEMBLY (ALL MODELS EXCEPT BATTERY POWERED)

REF	DESCRIPTION	PART NUMBER	QTY
10	Turret Assembly	40782 (48) 68076 (68) 68076 (58) 40815 (50)	1 1 1 1
-1	Turret Proportional Valve System	(See Figure 11)	1
-2	Gas Tank Assembly	(See Figure 14)	1
-3	Decal - "Gas"	21849	1
-4	Decal - "Hydraulic Fluid"	21850	1
-5	90° Elbow	202413-8-8	1
-6	Rod - Throttle Control	40165	1
-7	Cap	210292-8	1
-8	Pin Assembly, Anti - Rotation	40169	1
-9	Choke Mounting Bracket	68080	1
-10	90° Elbow	2024-4-4	1
-11	Pressure Hose - To Hydraulic Throttle	FG 1012-EEE-0204	1
-12	90° O-Ring Elbow	2062-6-6	2
-13	45° O-Ring Elbow	2061-4-4	1
-14	Hydro-Throttle Control	21462	1
-15	Mounting Plate	21780	1
+16	Solenoid	21342	1
-17	Self-Tapping Pan Head Screw	No. 7 x 3/4	2
-18	Solenoid	32111	1
-19	Ground Control Box Mounting Bracket	40792	1
-20	Counter Weight Bracket	40554	2
-21	Hex Head Capscrew	3/4 - 10 UNC x 2-1/4	2
-22	Lockwasher	3/4	2
-23	Hex Nut	3/4 - 10 UNC	2
-24	Hex Head Capscrew (Other End of Item 20)	3/4-10 UNC x 1-1/2	2
-25	Counterweight	40736 (48), 40736 (50) 40766 (58, 68)	
-26	Decal - "Manufacture"	15834	1
-27	Ground Control Box Assembly	(See Figure 16)	1
-28	Striker Plate	21793	2
-29	Hex Head Capscrew	7/16 x 14 UNC x 2-1/2	4
-30	Flat Washer	7/16	4
-31	Lockwasher	7/16	A/R
-32	Spacer	21797	4
-33	Hex Head Capscrew	1/2 - 13 UNC x 2 1/4 LG.	4
-34	Hex Nut	1/2 - 13 UNC	4
-35	Lockwasher	1/2	1
-36	Gas Engine	40017	1
-37	Hydraulic Pump	40650	
-38	Hydraulic Tank Assembly	(See Figure 15)	1
-39	Turret Rotation Speed Reducer	(See Figure 17)	1
-40	Hex Head Capscrew	5/8 - 11 UNC x 2 LG.	15
-41	Ring Gear	Ref. (See Fig. 3)	1
-42	Hex Locknut	5/8 - 11 UNC	15
-43	Gas Engine Assembly	40016	1

FIGURE 10 - TURRET ASSEMBLY (ALL MODELS EXCEPT BATTERY POWERED)

REF	DESCRIPTION	PART NUMBER	QTY
-44	Rotary Coupling	Ref. (See Fig. 3)	1
-45	Turret Weldment	(48) 40159, (58) 40160	1
		(50) 40158, (68) 40160	1
-46	Hex Head Capscrew	5/16 - 18 UNC	4
-47	Lockwasher	5/16	4
-48	Hex Nut	5/16 - 18 UNC x 1 3/4 LG.	4
-49	5 Degree Automatic Slope Control	Ref. (See Fig. 16)	1
-50	Lever - Rework	21867	1
-51	Starter Solenoid	21342	1
-52	Strap Alternator Belt Adjustment	40162	1
-53	Brake Alternator	40166	1
-54	Hex Head Capscrew (Grade 8)	5/8 - 11 UNC x 1-1/2	1
-55	Lockwasher	5/8	1
-56	Cover, Alternator Pulley	40170	1
-57	Operation and Safety Manual Holder	21383	1
-58	Round Head Capscrew	No. 10-32 UNF x 1-1/2	2
-59	Flatwasher	No. 10	2
-60	Decal - "Operation and Safety Manual"	21384	1
-61	Belt	Goodyear - MH184-A	1
-62	110 Volt Boom Electrical Line	See Figure 37	1
-63	Shroud	40019	1
-64	Electric Motor, Pump Assembly	40648	1
-65	Choke Mounting Bracket	68080	1

Technical drawing of a mechanical assembly, showing two views: a perspective view (top) and a top-down view (bottom).

The perspective view (top) shows the assembly mounted on a base. Key components labeled include:

- 1, 2, 3, 4, 5: Structural components and piping.
- 6, 7, 8, 9, 10, 11: Components on the right side.
- 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103: Numerous small components, valves, and connectors.
- A & B: A dashed line indicating a cross-section.

The top-down view (bottom) shows the internal layout of the assembly, including a large rectangular block with multiple ports and a smaller component on the right. Key components labeled include:

- 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103: Numerous small components, valves, and connectors.
- VIEW A: The label for the top-down view.

FIGURE II- TURRET PROPORTIONAL VALVE SYSTEM INSTALLATION

REF	DESCRIPTION	PART NUMBER	QTY
- 1	Hex Head Capscrew	1/4 X 28 UNC 3/4	7
- 2	Lockwasher	1/4	9
- 3	Mounting Clip	21564	5
- 4	Hydraulic Panel Cover	21565	1
- 5	Hydraulic Valve Plate Assembly	40038	1
- 6	Mounting Plate	21551	1
- 7	Hex Head Capscrew	3/8-16 UNC X 3/4 LG.	4
- 8	Lockwasher	3/8	9
- 9	Reducer	2081-12-6	2
-10	90° Elbow	2024-6-4	4
-11	Filter	21475	1
-12	Swivel Elbow	2071-8-8	1
-13	Tube Assembly	21799-3	1
-14	Needle Valve	21479	1
-15	Check Valve	21368	1
-16	Elbow, 90° Swivel	6500-6-6	1
-17	Adapter (with Filter)	Furnished with proportional Control Valve Pack	1
-18	Pipe, Straight	2404 4-4	1
-19	Check Valve	40795	1
-20	Reducer	TRTY-8-6	2
-21	Coupling Pipe	5404-4-6	1
-22	Flow Control, Berteau	21472	1
-23	Coupling Pipe	5404-4-4	1
-24	O-Ring Elbow	2062 -12-12	2
-25	Proportional Control Valve Assembly (see Figure 12)	40053	1
-26	O-Ring Adapter	202702-12-8	6
-27	Hex Head Capscrew	3/8-16 UNC X 5	3
-28	45° Swivel Elbow	2070-6-6	3
-29	Tee	203003-12-12 S	1
-30	Tube End Reducer	12-8S-TRBTX	1
-31	90° O-Ring Elbow	2062-6-6	2
-32	Holding Valve 3000 PSI	40104	1
-33	Hex Head Capscrew	1/4" X 28 UNC X 2 1/4" LG	2
-34	Tube Assembly	21799-6	1
-35	Elbow	2062-6-8 S	1
-36	Solenoid Control Valve Pack	40078	1
-37	O-Ring Elbow	6410-16-12	1
-38	Hex Head Capscrew	1/4-20 UNC X 3/4 LG.	4
-39	Hex Nut	1/4-20 UNC	4
-40	Flat Washer	1/4	4
-41	Lockwasher	1/4	6
-42	90° O-Ring Elbow	2062-4-6 S	1
-43	Adapter	2021-4-8	1
-44	Tube Assembly	21799-5	1
-45	O-Ring Adapter	202702-6-6 S	4
-46	Tube Assembly	21799-4	1

FIGURE II-TURRET PROPORTIONAL VALVE SYSTEM INSTALLATION

REF	DESCRIPTION	PART NUMBER	QTY
-47	Swivel Elbow	2071-8-8	1
-48	Adapter	2021-4-8	1
-49	Turret Hydraulic Hose Assembly	21890	1
-50	Hose Assembly	FG1012-GGG-0217	2
-51	Hose Assembly	FG1005-EEER-0300	1
-52	Hose Assembly	FA7229-GGG-0730	2
-53	Hose Assembly	FG101-GGG-0610	2
-54	Hose Assembly	FG1012-EEE-0480	2
-55	Hose Assembly	FC120-EBE-0170	2
-56	Hose Assembly	3634 (J. D. Furnished)	1
-57	Hose Assembly	FA4407-EBE-0280	1
-58	Hose Assembly	FG1556-KKK-0270	2
-59	Hose Assembly	FG1011-HHH-0660	2
-60	Hose Assembly	FG1005-GGG-0430	2
-61	Hose Assembly	FG1011-HHH-0296	1
-62	Hose Assembly	FG1011-KKK-0360	1
-63	Hose Assembly	FG1012-HHH-0200	1
-64	Hose Assembly	FG1012-EEE-0840	1
-65	Hose Assembly	FG1012-HHH-0200	1
-66	Hose Assembly	FG1012-HHH-1050	1
-67	Hydraulic Pump	40650	1
-68	Hose Assembly	FG1556-KKK-0270	2
-69	Hose Assembly	FG1012-GGG-0480	2
-70	Hose Assembly	FG1005-EEE-0274	2
-71	Hose Assembly	FG1012-GGG-0217 (6066)	1
-72	Hose Assembly	FG1012-GGG-0480 (6066)	1
-73	Hose Assembly	FA4407-EBE-0280 (6066)	1
-74	Solenoid	21491	1
-75	90° Elbow	2024-6-4 (6066)	1
-76	Hex Head Capscrew	1/4-20 UNC-1 1/2	2
-77	Lockwasher	1/4	2
-78	90° Elbow	2103	1
-79	Tee	3604-4-4-4	1
-80	Cap	#4	1
-81	Tee	2601-4-4-4	1
-82	Tee	2605-6-4-6	2
-83	O-Ring Plug	21569 #12 (modified)	1
-84	Cap	304-C-6	2
-85	Bushing, Pipe Reducing	2081-12-4	1
-86	Service Tee	2092-12-12	1
-87	Elbow, 45° Male	2503-12-12	1
-88	90° O-Ring Elbow	2062-6-6	2
-89	45° O-Ring Elbow	2061-4-4	1
-90	90° O-Ring Elbow (modified)	21570	1
-91	Male Pipe Coupling	5404-12-12	1
-92	Bushing, Pipe Reducing	5406-6-4	1
-93	Adapter, straight	2404-6-4	1
-94	Tee	5602-4-4-4	1
-95	90° Elbow	2062-6-4	2

FIGURE II - TURRET PROPORTIONAL VALVE SYSTEM INSTALLATION

REF	DESCRIPTION	PART NUMBER	QTY
-96	Multi-Axis Slope Sensor	32583	1
-97	Solenoid	21342	1
-98	Electric Motor	40649	1
-99	Adapter (modified)	21569	11
-100	Pipe Reducer Bushing	5406-12-12-4	1
-101	Hex Nut	3/8 - 16 UNC	5
-102	Hex Head Capscrew	3/8 - 16 UNC x 3 1/2 LG.	2
-103	O -Ring Elbow	2061-6-6	2

FIGURE 11A TURRET PROPORTIONAL VALVE SYSTEM DIAGRAM

(ALL MODELS)

1. SEE TABULATION FOR CONNECTIONS OF VARIOUS ITEMS.
2. ALL COMPONENTS MUST BE CLEAN INTERNALLY PRIOR TO INSTALLATION.
3. FLUSH ALL HOSES PRIOR TO INSTALLATION.

NOTES

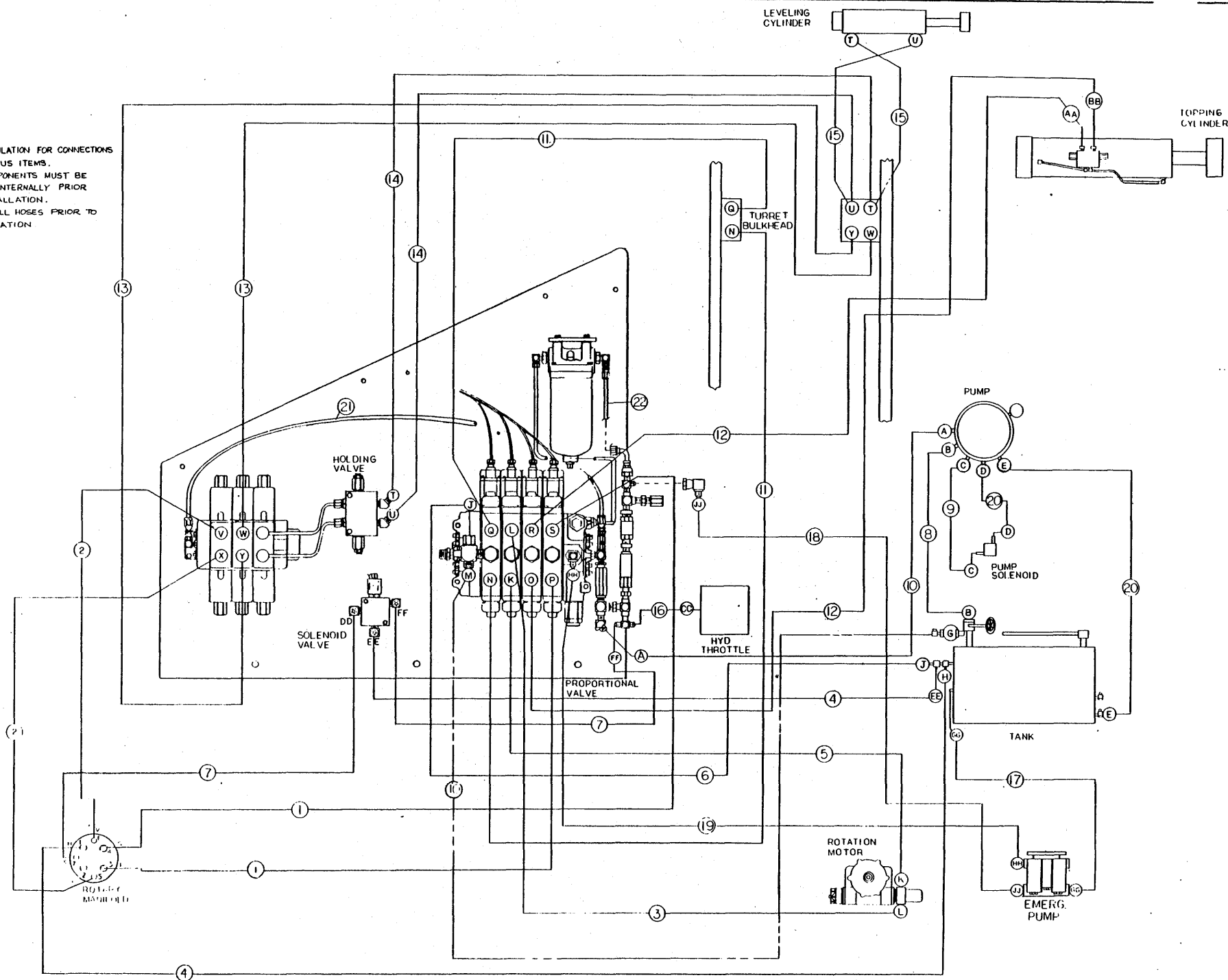
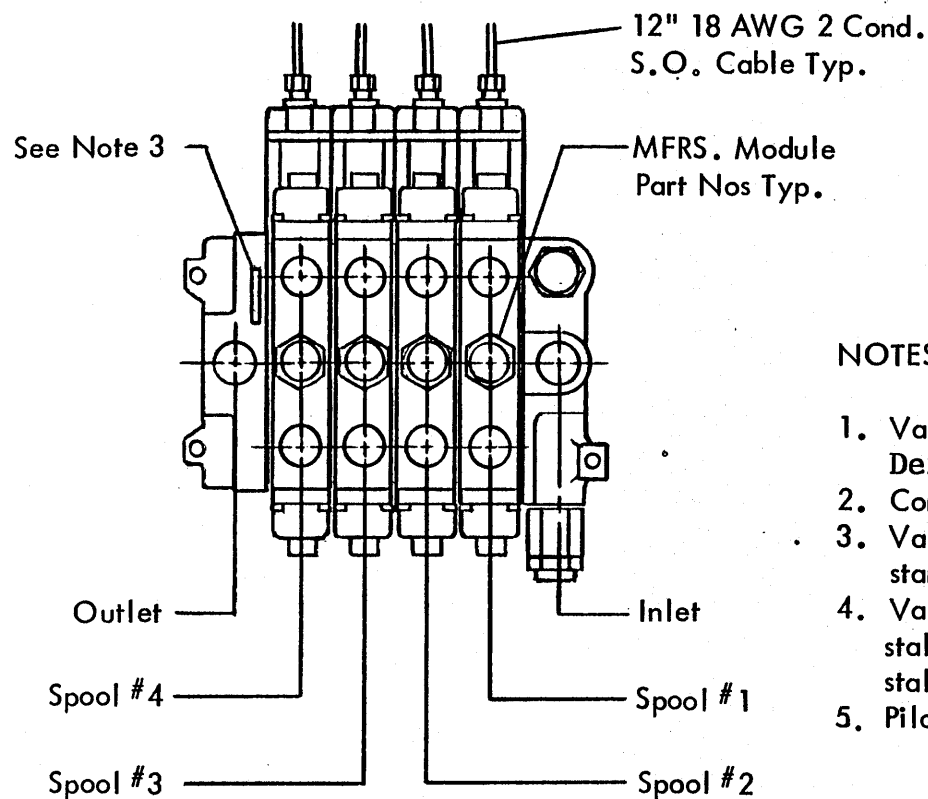


FIGURE IIA TURRET PROPORTIONAL VALVE SYSTEM DIAGRAM

REF	DESCRIPTION	PART NUMBER	QTY
1	Hose Assembly	9812-1890-0270	2
2	Hose Assembly	9804-1890-0270	2
3	Hose Assembly	9808-1818-0200	1
4	Hose Assembly	9806-1818-0480	2
5	Hose Assembly	9808-1818-0150	1
6	Hose Assembly	9808-1818-0296	1
7	Hose Assembly	9804-1818-0280	2
8	Hose Assembly	5520-1818-0200	1
9	Hose Assembly	9804-1818-0480	1
10	Hose Assembly	9812-1818-0360	2
11	Hose Assembly	9808-1818-0660	2
12	Hose Assembly	9806-1891-0684	2
13	Hose Assembly	9806-1818-0730	2
14	Hose Assembly	9806-1818-0610	2
15	Hose Assembly	9804-1818-0170	2
16	Hose Assembly	9804-1818-0420	1
17	Hose Assembly	9808-1818-0420	1
18	Hose Assembly	9806-1891-0580	1
19	Hose Assembly	9806-1891-0490	1
20	Hose Assembly (John Deere)	3CIT-3F JX-4F JX-36	2
21	Hose Assembly	9804-1890-0450	1
22	Hose Assembly	9806-1890-0160	1

FIGURE 12 - TURRET PROPORTIONAL CONTROL VALVE ASSEMBLY (ALL MODELS)



PART NUMBER

40053-A

NOTES:

1. Valve Assembly to operate at 2150 PSI & 160° F. Hydr. oil to be Dexron II or equal
2. Completed Assembly to be thoroughly tested prior to ship-
3. Valve Assembly to be supplied with Berteag part number 250825-10.1B stamped in 7/32" high characters as shown.
4. Valve Assembly to be supplied complete with 1/2" NPT plug installed internally in power beyond port and 1/4" NPT plug installed in port 'D' of outlet section.
5. Pilot pressure relief valve setting to be 300 PSI

Sub. Assem.	Part No.	Function	Type							Comments
				Flow	Travel		Part No.	I.D.	Port	
Inlet	269381-7				C2 Port					Relief Valve
Spool 1	2A05-21	Drive	Motor	9 GPM	.320		700266	21	100% Open.	2750 PSI
Spool 2	1A04-2	Lift	Cyl.	2.5 GPM	.320		248507	2	Blkd.	
Spool 3	2A04-2	Rotate	Motor	4 GPM	.320		248507	2	Blkd.	
Spool 4	1A05-3	Extend	Cyl.	5 GPM	.280		248508	3	Open	
Outlet	269382-9									Power beyond w/ separate P.V. drain

FIGURE 13 TURRET PUMP INSTALLATION (ALL MODELS)

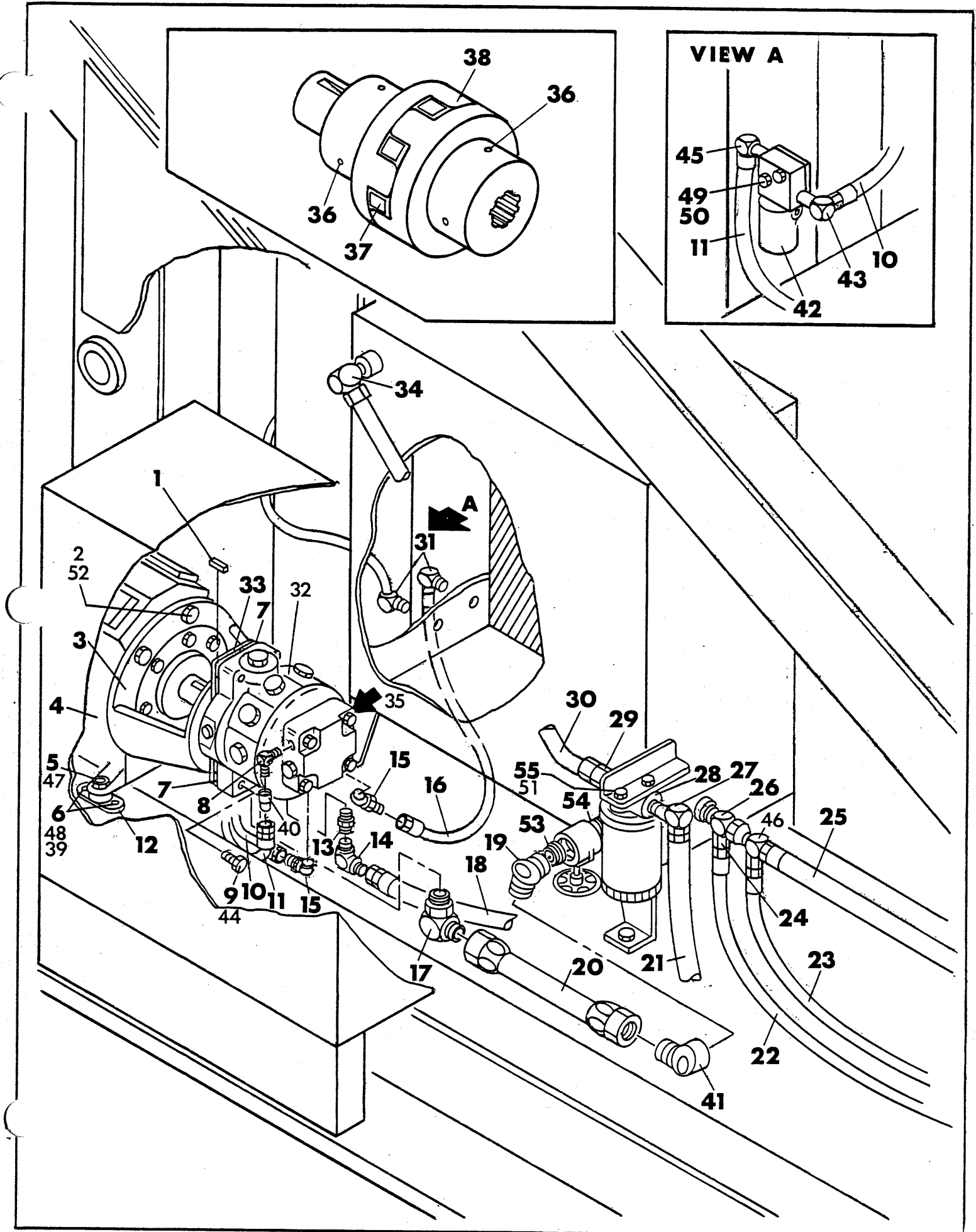


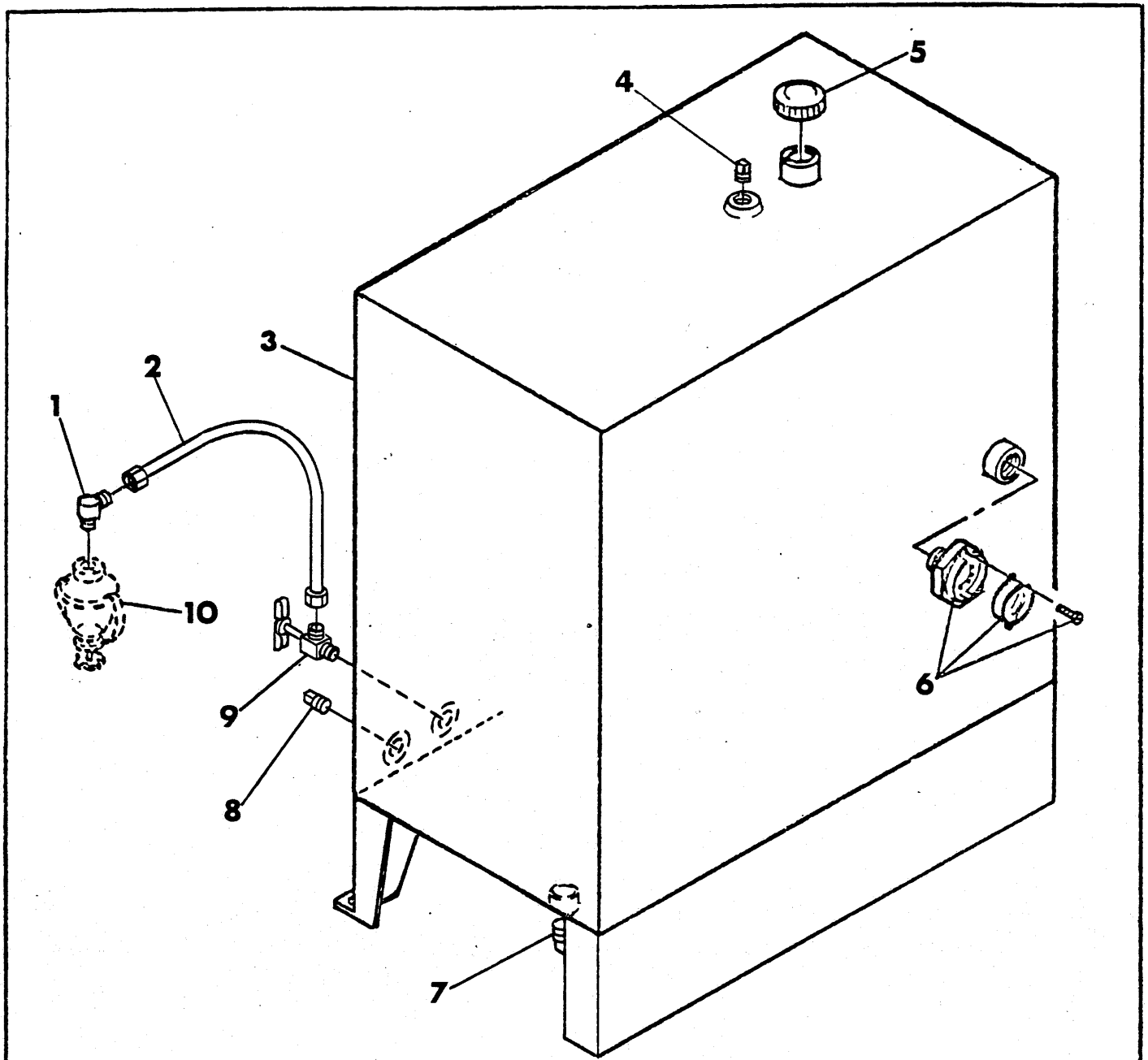
FIGURE 13 - TURRET PUMP INSTALLATION (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
1	Key Stock	3/8 x 3/8 x 1-1/2	1
2	Hex Head Capscrew, GRD. 8	5/8 - 11 UNC x 1 3/4 LG.	4
3	Pump Adapter	40171	1
4	Gas Engine	32146	1
5	Hex Head Capscrew	5/8 x 2	4
6	Hex Head Capscrew	5/16 x 1	8
7	Spacer	40231	2
8	O-Ring Elbow	2062 6-4	1
9	Hex Head Capscrew	1/2 - 13 UNC x 2 1/2 LG.	4
10	Hose Assembly	FG 1005-EEER-0300	1
11	Hose Assembly	FG 1012-EEE-0480	1
12	Engine Rubber Mount	40532	4
13	O-Ring Adapter	202702 10-12	1
14	90° Swivel Elbow	2071 12-12	1
15	O-Ring Elbow	3/8 3-4	2
16	Hose Assembly	3C1T-3FJX- 4FJX-36	1
17	90° O-Ring Elbow	2026 20-20	1
18	Hose Assembly	FG 1011-KKK-0360	1
19	45° O-Ring Elbow	Airway 2503-20-20	1
20	Hose Assembly	FG 1556-KKK-0270	1
21	Hose Assembly - To Hydraulic Panel	FG 1012-KKK-0360	1
22	Hose Assembly - To Rotary Coupling	FG 1012-GGG-048	1
23	Hose Assembly - To Hydraulic Panel	FG 1012-GGG-0480	1
24	Reducer	1290-8	1
25	Hose Assembly	FG 1011-HHH-0296	1
26	Tee	203102 8 - 8 "T"	1
27	90° Elbow	2024 16-12	1
28	Filter	32522	1
29	Adapter	2121 16-16	1
30	Tube Assembly	21799-7	1
31	90° Elbow	2024 4-4	2
32	Pump Assembly	21851	1
33	Bracket, "T" Adapter	32089	1
34	90° Elbow	2024 16-16	1
35	Pump Compensator Adjustment	Reference Only	
36	Set Screw, Allen Head Cup Point	5/16 - 18 x 3/8 LG.	4
37	Spider	40233	1
38	Coupling	40187	1
39	Lockwasher	5/16	8
40	Reducer	221501 TRTX 6-4	1
41	45° O-Ring Swivel Elbow	6502-20-20	1
42	Pump Solenoid Valve	21465	1
43	90° O-Ring Elbow	202413 4-4	1
44	Lockwasher	5/16	4
45	90° O-Ring Elbow	2024 4-4	1
46	Swivel Tee	203102 8-8 "T"	1
47	Lockwasher	5/8	4
48	Lockwasher	5/16	8

FIGURE 13 - TURRET PUMP INSTALLATION (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
49	Hex Head Capscrew	1/4 - 20 UNC x 2" LG.	2
50	Lockwasher	1/4	2
51	Lockwasher	1/4	2
52	Lockwasher	5/8	4
53	Reducer	5406-20-16	1
54	Close Pipe Nipple	13404 1-1/2 NPT	1
55	Hex Head Capscrew	1/4 - 20 UNC x 1/2 LG.	2

FIGURE 14 - FUEL TANK ASSEMBLY (ALL MODELS)



REF	DESCRIPTION	PART NUMBER	QTY
14-	Fuel Tank Assembly	21743	1
- 1	90° Brass Elbow	69 x 4	1
- 2	Copper Tube Assembly	1/4 x 20	1
- 3	Fuel Tank Weldment	21236	1
- 4	Pipe Plug	3/8 NPT	1
- 5	Filler Cap	FC1.5-S	1
- 6	Fuel Gauge	GA-VE-FA-26	1
- 7	Pipe Plug	1" NPT	1
- 8	Pipe Plug	1/8 NPT	1
- 9	Valve	6600	1
-10	Engine Sediment Bowl	(Reference)	1

FIGURE 15 - HYDRAULIC TANK ASSEMBLY (ALL MODELS)

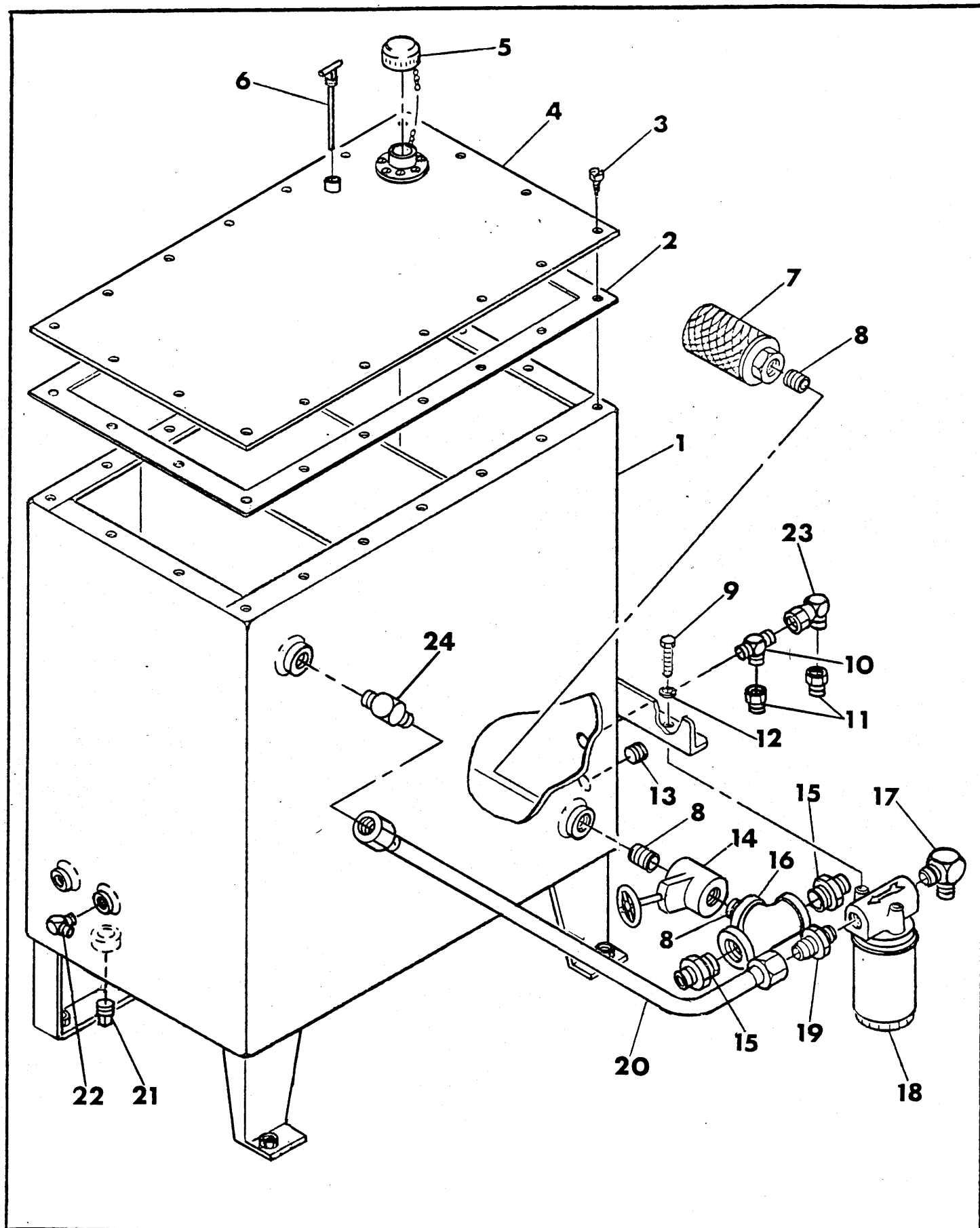


FIGURE 15 - HYDRAULIC TANK ASSEMBLY (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
15-	Hydraulic Tank Assembly	21742	1
- 1	Hydraulic Tank Weldment	21237	1
- 2	Gasket	Part of 21237	1
- 3	No. 12 Type-C, Self-Tapping Screw X $\frac{1}{2}$ " Long	Part of 21237	18
- 4	Cover	Part of 21237	1
- 5	Filler Breather Unit (Tank Cap)	50316 - (A100W)	1
- 6	Dip Stick	21192	1
- 7	Sump Strainer	21473	1
- 8	Close Pipe Nipple	1- $\frac{1}{2}$ NPT	3
- 9	Hex Head Capscrew	$\frac{1}{2}$ -20 UNC X 5/8	2
-10	Tee	2028-8-8	1
-11	Reducer	2215-8-6 (4248,6066)	2
-12	Lockwasher	1/4	2
-13	Allen Head Pipe Plug	Part of 21237	1
-14	Bronze Gate Valve	T180 x 1 1/2	1
-15	Reducer	2021-24-12	2
-16	Tee	1- $\frac{1}{2}$ SCHD 40 B.P.	1
-17	90° Elbow	2024-16-12	1
-18	Filter	32522	1
-19	Adapter	2021-16-16	1
-20	Tube Assembly	21799-7	1
-21	Pipe Plug (1" NPT)	Part of 21237	1
-22	90° Elbow	2024-4-4	2
-23	Swivel Tee	203102-8-8 (6066)	1
-24	90° Elbow	2024-16-16	1

FIGURE 16 GROUND CONTROL BOX ASSEMBLY

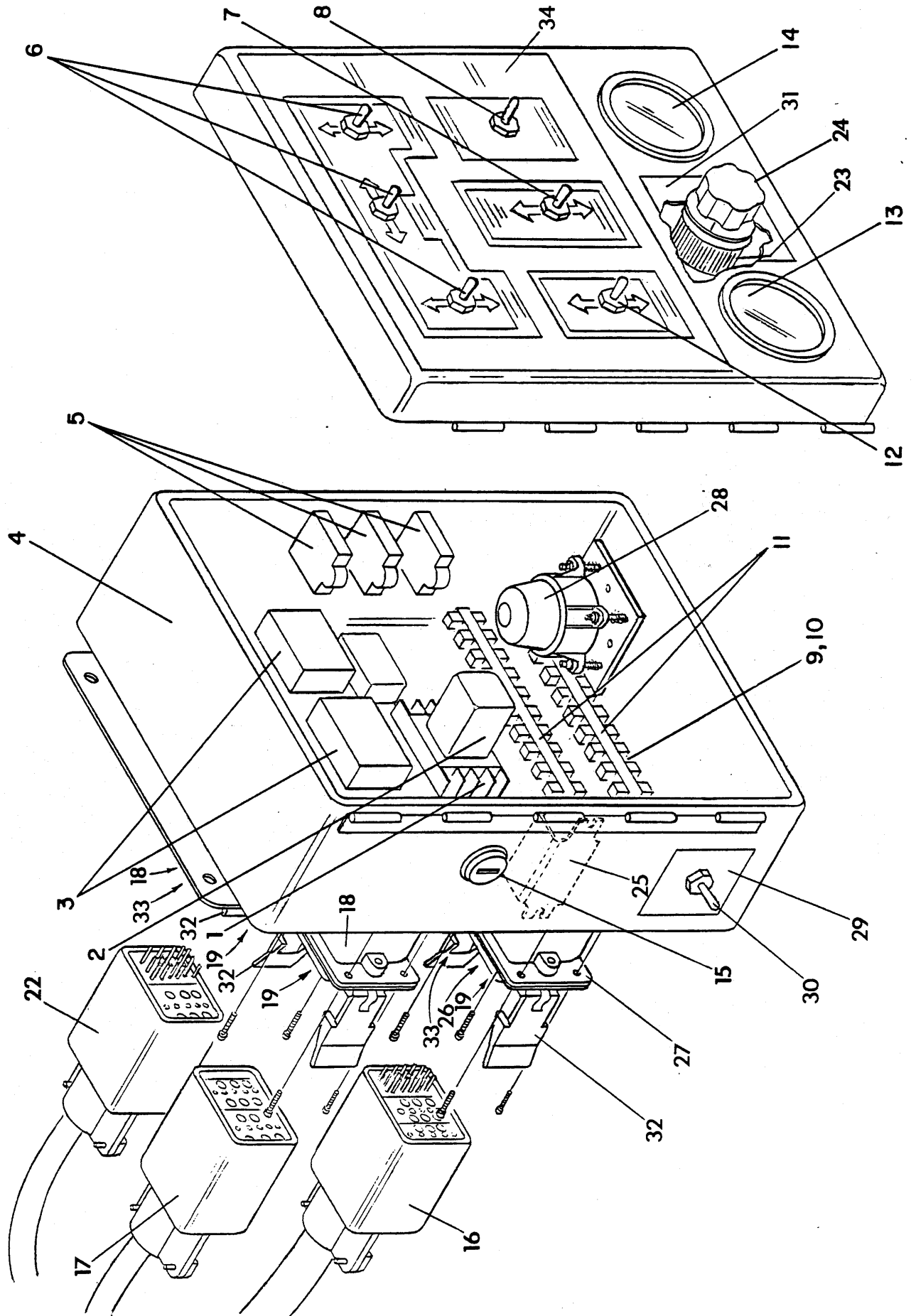


FIGURE 16 GROUND CONTROL BOX ASSEMBLY

REF	DESCRIPTION	PART NUMBER	QTY
16-	Ground Control Box Assembly	40788	1
1	Socket Base	80373	1
2	Relay	80024	1
3	Latching Relay	80023	2
4	Box, Machining	32558	1
5	Circuit Breaker	80025	3
6	Micro-Switch	80058	3
7	Micro-Switch	80026	1
8	Switch	80372	1
9	Clamp Channel	80041	4
10	Mounting Channel	80040	2
11	Terminal Block	80029	16
12	Start/Stop Switch	80306	1
13	Hour Meter	80027	1
14	Ammeter	(Engine Assy.) YEZ	1
15	Ignition Switch	80043	1
16	Boom Cable Assembly	Ref.	1
17	Engine Cable Assembly	68082	1
18	Plug G2, AMP Special Ind.	80374	2
19	11 Pin Module, AMP	80355	3
20	Pin, AMP	80359	38
21	Pin, AMP	80358	18
22	Valve Cable Harness	68074	1
23	Rheostat, 350 OHM	80378	1
24	Knob	80375	1
25	Relay	80377	1
26	23 Pin Module AMP	80370	1
27	Plus G3, AMP Special Ind.	80368	1
28	Alarm, Multi Axis	32002	1
29	Decal, Choke	32195	1
30	Switch, Choke	80305	1
31	Decal Slow/Fast	32582	1
32	Locking Latch Assembly	80360	3
33	23 Pin Module	80356	1
34	Ground Control Panel Decal	21422	1

FIGURE 17 - TURRET ROTATION SPEED REDUCER INSTALLATION (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
17-	Turret Roation Speed Reducer Installation		
1	Turret Speed Reducer**	21739	1
2	Key	1/4 Sq. x 1	1
3	Connector	202702-10-8	2
4	Motor Hydraulic	32762	1
5	Lockwasher	3/8	2
6	Hex Head Capscrew	3/8-16 UNC x 1	2
7	Turret Rotation Pinion	21740	1
		21906 (48)	1
8	Lockwasher	5/8	4
9	Hex Socket Head Capscrew	5/8-11 UNC x 1-1/2	4
10	Valve Cross Over Relief	32763	1
11	Turret Base Plate	(See Fig. 13B)	1
12	Adjustable Speed Reducer Mounting Assembly	21435	1
13	Lockwasher	5/8	3
14	Hex Head Capscrew	5/8-11 UNC x 1-1-1/4	3
15	Flat Washer	5/8 SAE STD.	2
16	Flat Washer	2 OD x 1/16 x 1/4 THR	1
17	Hex Nut	3/4 x 10 UNC	1
18	Square Head Capscrew	3/4 x 10 UNC x 4	1
	** See Vendor Section for further Breakdown.		

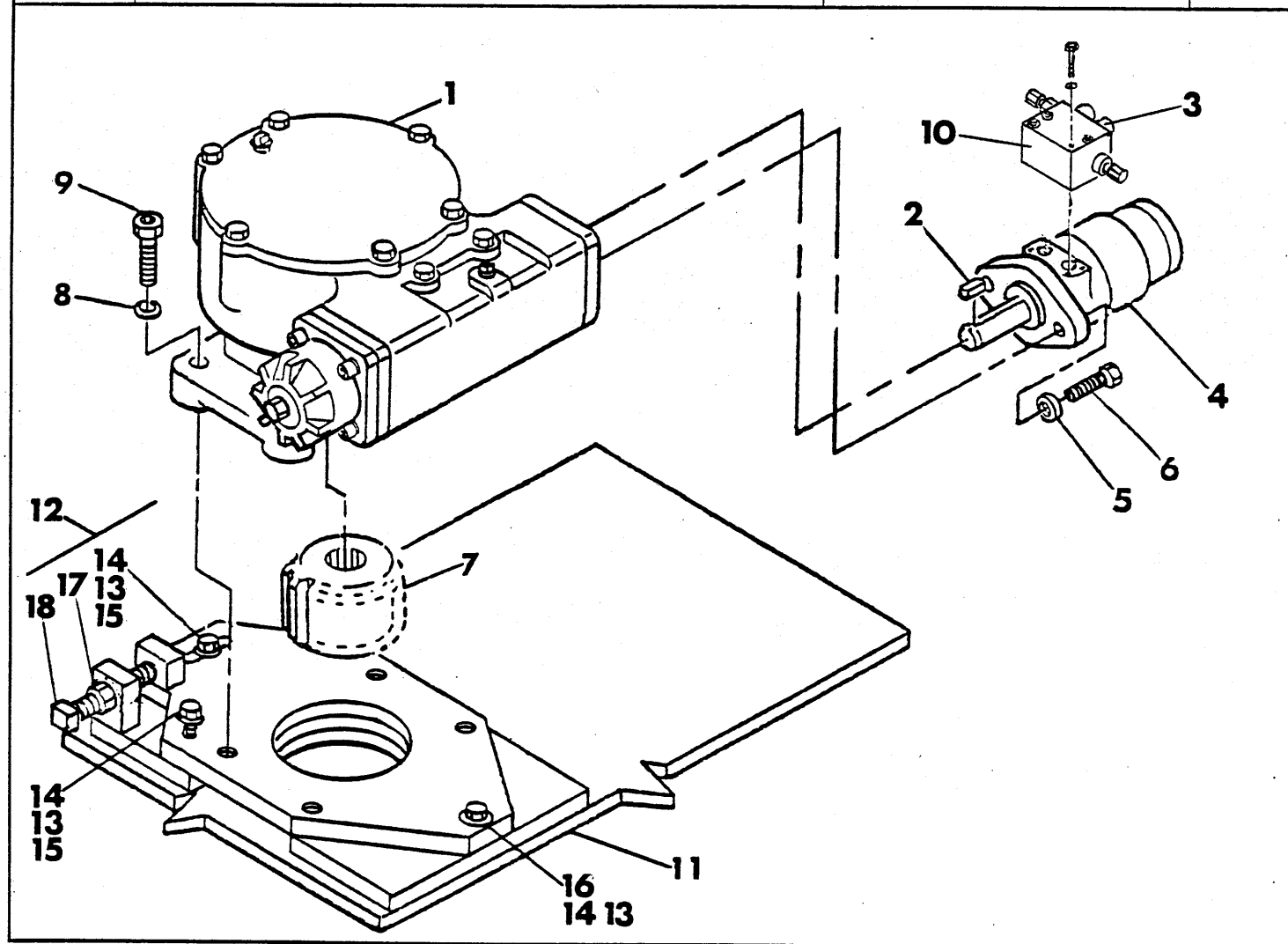
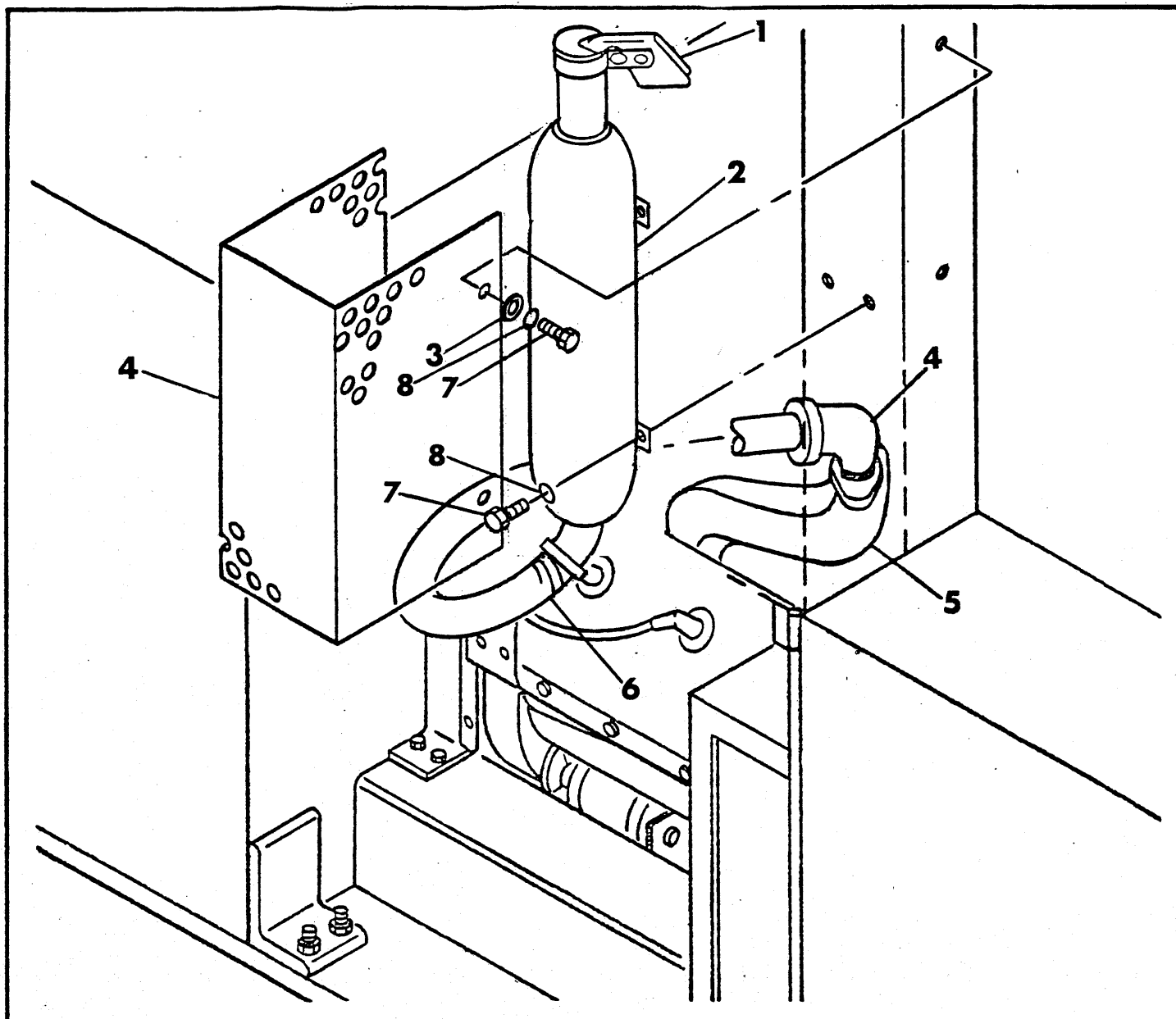


FIGURE 18 - MUFFLER INSTALLATION (ALL MODELS)



REF	DESCRIPTION	PART NUMBER	QTY
18-	Muffler Installation	Part of 40782 (48), 68076 68076	1 1 1
- 1	Rain Cap	21563	1
- 2	Muffler	21515	1
- 3	Flatwasher	5/16	1
- 4	Muffler Guard	21826	1
- 4	90° Street Elbow	1-1/4 NPT	1
- 5	Engine Manifold	Part of 40017	1
- 6	Flexible Exhaust Tube Assembly	40097	1
- 7	Hex Head Capscrew	5/16-18 UNC X 3/4	8
- 8	Lockwasher	5/16	8

FIGURE 19 AIR CLEANER, WARNING HORN AND BATTERY INSTALLATION

REF	DESCRIPTION	PART NUMBER	QTY
19-	Air Cleaner and Battery Installation	Part of 40782 (48), 40815 (50) 68076 (58), 68076 (68)	1
-1	Flex Hose	FM127-2 X 33	1
-2	Hose Clamp	4-7997	2
-3	Air Intake Tube	LJ-120 X 6	1
-4	Hose Clamp	LK-8	1
-5	Hex Head Cap Screw	1/4" - 20 UNC x 1/2"	4
-6	Lock Washer	1/4"	4
-7	Air Cleaner	LO-157-1-51	1
-8	Air Cleaner Baffle Plate	40021	1
-9	Capscrew, Hex Hd.	5/16" - 18 UNC x 3"	2
-10	Flat Washer	5/16"	2
-11	Hex Nut	5/16" - 18 UNC	2
-12	Battery Clamp	40164	2
-13	Battery (Exide)	32614	1
-14	Solenoid	21342	1
-15	Hex Head Cap Screw	5/16" - 18 UNC x 1 LG.	2
-16	Cable	PBL-19	2
-17	Cable	372	2
-18	Decal, Battery	21399	1
-19	Warning Horn	80188	1

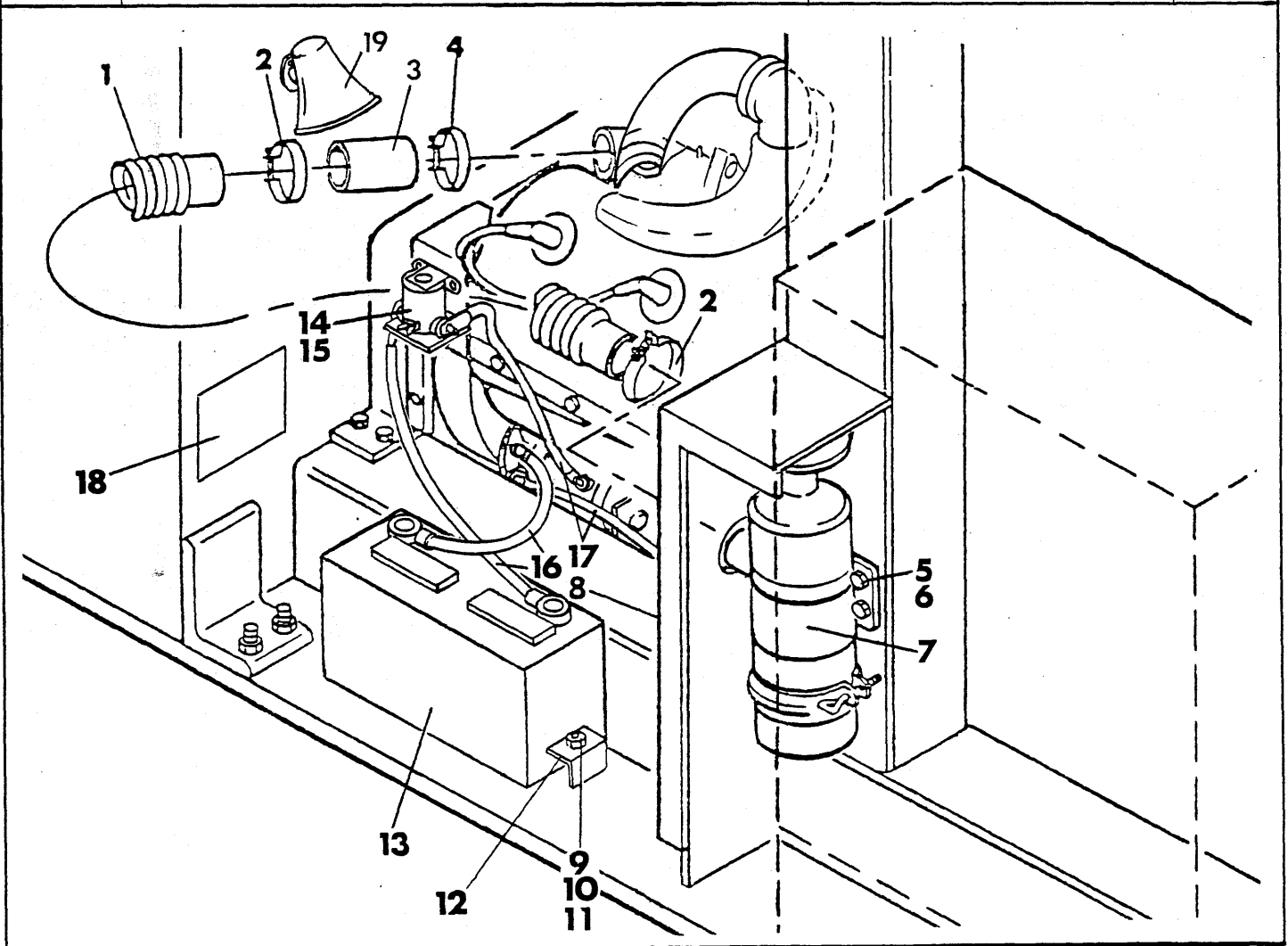


FIGURE 21 BOOM ASSEMBLY (58, 68) Beginning with Serial #4934

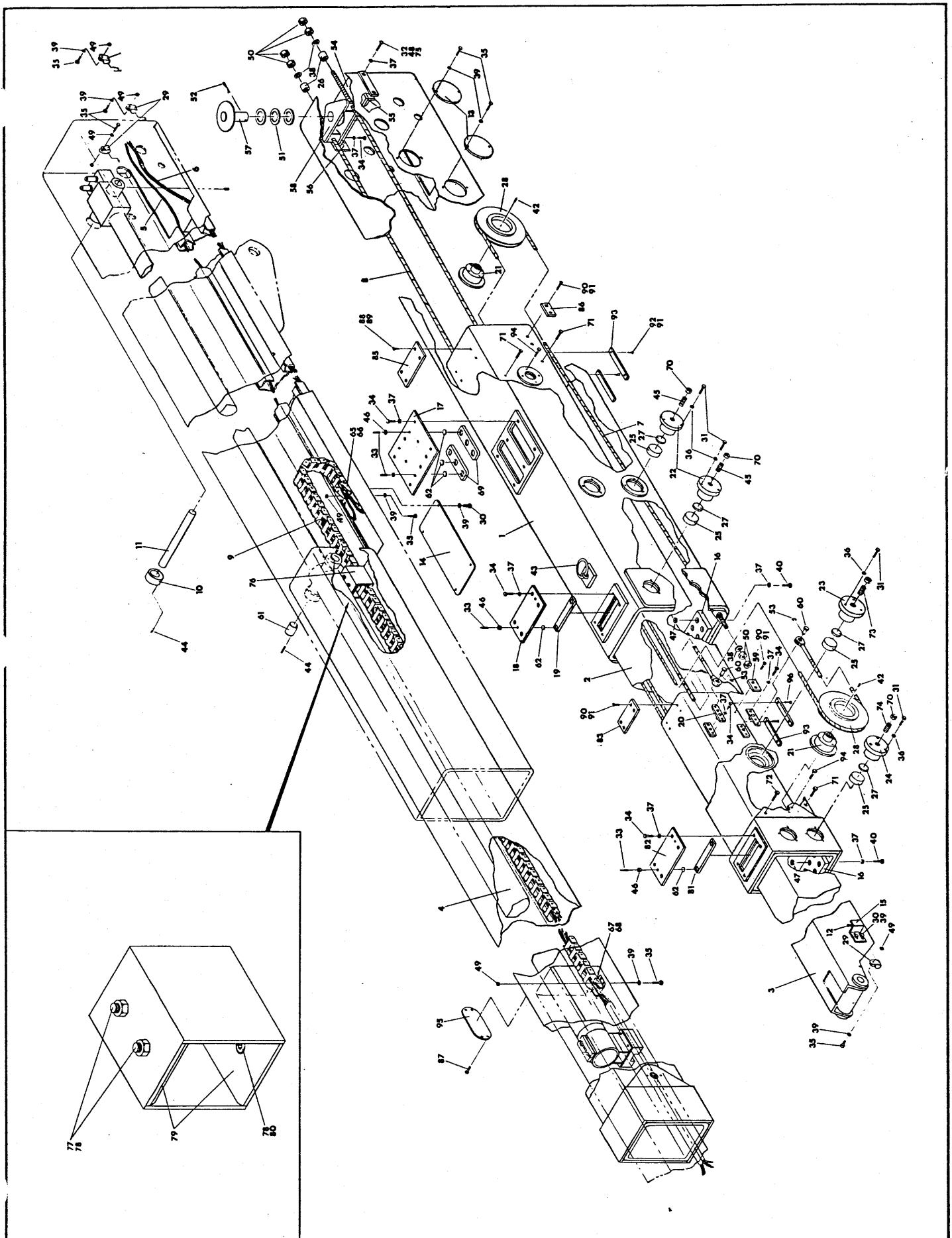


FIGURE 21 BOOM ASSEMBLY (58,68) Beginning with Serial # 4934

REF	DESCRIPTION	PART NUMBER	QTY
1	Outer Boom Fabrication	68147	1
2	Inter Boom Fabrication	68146	1
3	Inner Boom Fabrication	68138	1
4	Extension Cylinder Assembly	68260 (See Fig.)	1
5	Electrical Cable Assembly	68046	1
6	Hydraulic Hose Assembly	80143-004	4
7	Wire Rope Assembly, Retraction	68256	2
8	Wire Rope Assembly, Extension	68257	2
9	Plastitrak	32603-007	1
10	Eccentric	68161	2
11	Pin, Main Boom Extension Cylinder	21808	1
12	Limit Switch	40208	1
13	Plate, Cover	68179	4
14	Plate, Cover	68223	1
15	Bracket, Limit Switch	68090	1
16	Wear Pad, Bottom Front	68164	2
17	Back-up Plate	68166	1
18	Back-up Plate, Top Front	32718	
19	Wear Pad, Top Front	68167	
20	Dead End Bracket Assembly	68228	4
21	Pin, Sheave	68050	4
22	Holder, Wear Pad	68184	8
23	Holder, Wear Pad	68186	2
24	Holder, Wear Pad	68185	4
25	Wear Pad	68187	14
26	Spacer, Evener	68206	2
27	Spacer, Wear Pad	68183	14
28	Sheave Assembly	68067	4
29	Clamp, Cable (Bowman #32585-1) Size: 1"		6
30	Capscrew, Hex Hd. 1/4"- 20 UNC x 1/2" Lg. GR8		6
31	Capscrew, Hex Hd. 5/16"- 18 UNC x 1" Lg. GR8		42
32	Flat Head Socket Screw 3/8"-16 UNC x 1-1/2" Lg.		4
33	Setscrew, Socket Head 1/2"-20 UNF x 1" Lg.		10
34	Capscrew, Hex Hd. 3/8"- 16 UNC x 1" Lg. GR8		26
35	Capscrew, Hex Hd. 1/4"- 20 UNC x 3/4" Lg. GR8		22
36	Lockwasher, 5/16"		42
37	Lockwasher, 3/8"		42
38	Washer, 3/4"		4
39	Lockwasher, 1/4"		28
40	Capscrew, Hex Hd. 3/8"- 16 UNC x 1-1/4" Lg. GR8		12
42	Zerk Fitting, Straight 1/4"- 28 UNF (SAE LT)		4
43	Tie Down Ring (HADCO)	32536	1
44	Setscrew, Socket Hd. 3/8"- 16 UNC 1/2" Lg.		4
45	Setscrew, Socket Hd. Cuppt. 5/8"-11 UNC x 1-1/2"		8

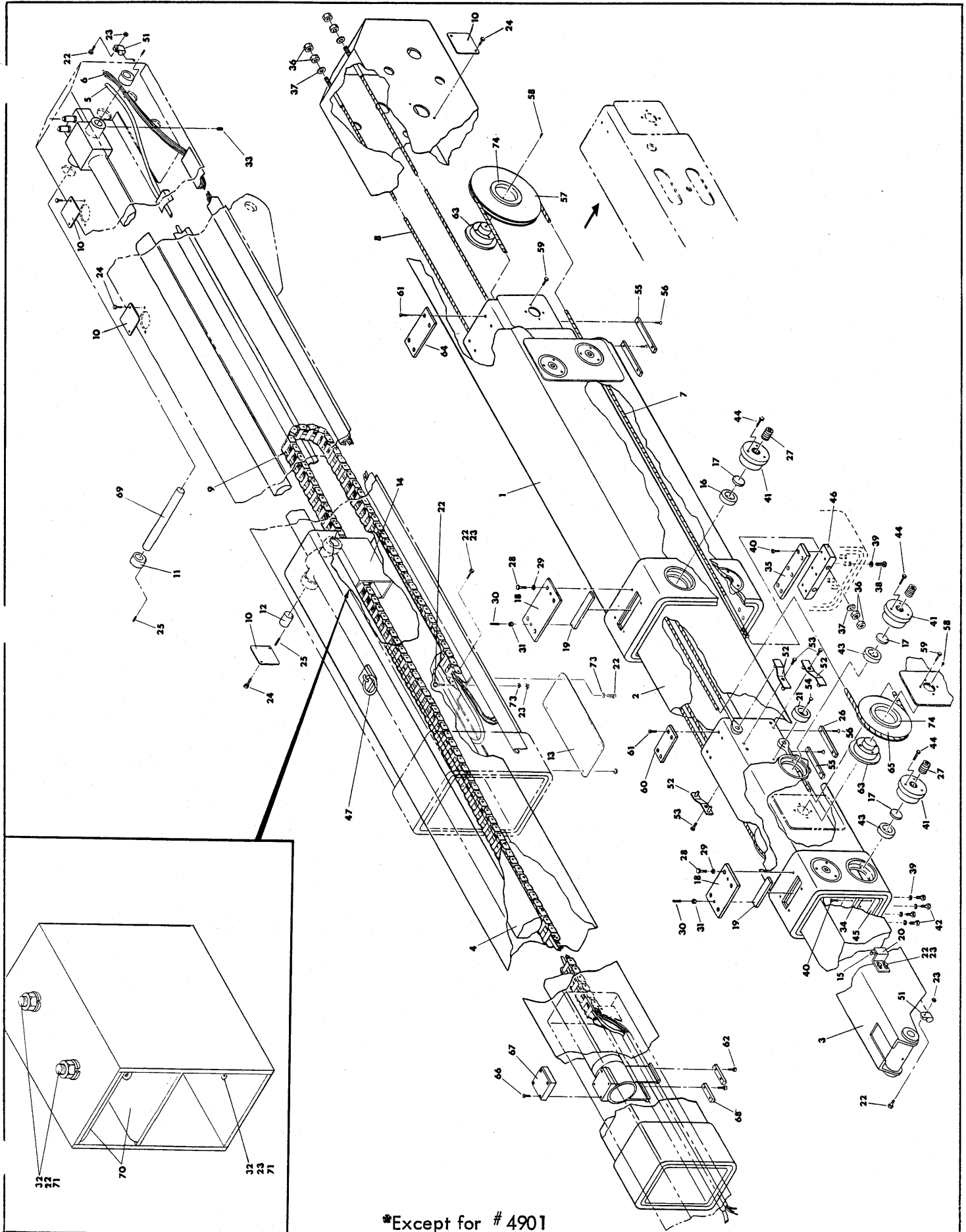
FIGURE 21 BOOM ASSEMBLY (58,68) Beginning with Serial # 4934

REF	DESCRIPTION	PART NUMBER	QTY
46	Jam Nut, 1/2" - 20 UNF		10
47	Nut, Tee - 4 prong	68276	12
48	Nut, 3/8" - 16 UNC		4
49	Nut, 1/4" - 20 UNC		14
50	Nut, 3/4" - 10 UNC		8
51	Washer, 1-1/4" SAE		3
52	Cotter Pin, Steel 3/16" x 2-1/2"		1
53	"E" Ring	68275	4
54	Evener Support, Mounting Plate	68264	1
55	Bracket, Mounting - LH	68265	1
56	Bracket, Mounting - RH	68269	1
57	Pin Weldment, Main Pivot	68267	1
58	Evener Brkt., Trunnion Weldment	68268	1
59	Wear Pad, Side	68273	2
60	Pin, Cable End	68189	4
61	Pin, Trunnion	68270	2
62	Fender Washer (Bowman #32570)		10
65	Movable Bracket, LH	68199	1
66	Movable Bracket, RH	68200	1
67	Stationary Bracket, LH	68201	1
68	Stationary Bracket, RH	68202	1
69	Wear Pad, Top	68271	2
70	Jam Nut, 3/8" - 11 UNC		12
71	Capscrew, Hex Hd. 1/2 - 20 UNF x 1" Lg. GR8		6
72	Capscrew, Hex Hd. 1/2 - 20 UNF x 1-1/4" Lg. GR8		2
73	Setscrew, Socket Hd. Cup pt. 5/8 - 11 UNC x 1" Lg.		2
74	Setscrew, Socket Hd. Cup pt. 5/8 - 11 UNC x 2" Lg.		4
75	Washer, 3/8"		4
76	Guide Bracket Assembly	68245	1
77	Capscrew, Flat Hd. Socket 1/4" - 20 UNC x 3/4" Lg.		2
78	Nut, Hex 1/4" - 20 UNC (Bowma - Grip)	68413-000	4
79	Wear Pad	68248	2
80	Capscrew, Flat Hd. Socket 1/4" - 20 UNC x 1-1/4"		2
81	Wear Pad	68412	1
82	Back up Plate	68036	1
83	Wear Pad, Top	68182	1
84	Capscrew, Flat Hd. Socket 3/8" - 16 UNC x 1" Lg.		4
85	Wear Pad, Top	68349	1
86	Wear Pad, Side	68272	2
87	Flat Head Socket Screw 1/4" - 20 UNC x 1/2" Lg.		8
88	Capscrew, Flat Hd. Socket 1/4" - 20 UNC x 1" Lg.		4
89	Nut, Hex 1/4" - 20 UNC (Bowma - Grip)	68413-000	4
90	Capscrew, Flat Hd. Socket 3/8" - 16 UNC x 1-1/4"		2

FIGURE 21 BOOM ASSEMBLY (58,68) Beginning with Serial # 4934

REF	DESCRIPTION	PART NUMBER	QTY
91	Nut, Hex 3/8"-16 UNC (Bowma - Grip)	68413-002	16
92	Screw, Flat Hd. Socket 3/8"-16 UNC x 1-3/4" Lg.		4
93	Wear Pad, Bottom	68180	4
94	Capscrew, Socket Hd. 1/4"-20 UNC x 1" Lg.		16
95	Cover, Access (Side)	68274	2

FIGURE 21 BOOM ASSEMBLY (58,68) Beginning with Serial # 4898*



*Except for # 4901

FIGURE 21 BOOM ASSEMBLY (58, 68) beginning with Serial # 4898*

REF	DESCRIPTION	PART NUMBER	QTY
1	Outer Boom Fabrication	68113	1
2	Intermediate Boom Assembly	68214	1
3	Inner Boom Assembly	68018	1
4	Extention Cylinder Assembly	68069 (68) 58020 (58)	1
5	Electric Cable Assembly	68046	1
6	Hydraulic Hose Assembly	80143-4	4
7	Wire Rope Assembly-Retracton	68070	2
8	Wire Rope Assembly-Extension	68071	2
9	Plastitrak (126 links)	32603-8	1
10	Cover	68042	5
11	Eccentric	68039	2
12	Pin, Trunion	68041	2
13	Cover, Access	32761	1
14	Bracket Guide Assembly (Plastic-Trak)	68218	1
15	Limit Switch	40208	1
16	Wear Pad, Side	68025	8
17	Wear Pad Disc	68027	14
18	Plate, Wear Pad	32718	2
19	Wear Pad	68167	2
20	Bracket, Limit Switch	68090	1
21	Wear Pad, Side	68088	2
22	Capscrew, Hex Hd. 1/4" - 20 NC x 3/4" LG.		18
23	Nut, Hex 1/4" - 20 NC		20
24	Capscrew, Hx. Hd. 1/4" - 20 NC x 3/8" LG.		12
25	Set Screw, Socket Hd. 3/8" - 16 UNC x 1/2" LG.		4
26	Wear Pad, Bottom	68092	2
27	Set Screw, Socket Hd. 5/8" - 11 UNC x 3/4" LG.		14
28	Capscrew, Hx. Hd. 3/8" - 16 UNC x 5/8" LG.		8
29	Lockwasher, 3/8"		8
30	Set Screw, Socket Hd. 1/2" - 20 UNF x 3/4" LG.		4
31	Jam Nut, 1/2" - 20 UNF		4
32	Capscrew, Flat Hd. Socket 1/4" - 20 UNC x 3/4" LG.		6
33	Set Screw, 3/8" - 16 UNC x 1" Lg.		2
34	Wear Pad, Forward (Intermediate)	68054	1
35	Wear Pad, Forward (Outer)	68053	1
36	Nut, Hx. 3/4" - 10 UNC		8
37	Washer, 3/4"		4
38	Machine Screw, Hx. Hd. 5/8" - 11 UNC x 1 3/4" LG.		4
39	Lockwasher, 5/8"		8
40	Capscrew, Flat Hd. Socket 1/2" - 13 UNC x 1" LG.		10
41	Bracket, Wear Pad	68028	14
42	Capscrew, Hx. Hd. 5/8" - 11 UNC x 1-3/4" LG.		4
43	Wear Pad, Side (Intermediate)	68084	6
44	Capscrew, Socket Hd. 1/4" - 20 UNC x 1/2" LG.		42
45	Holder, Wear Pad	68045	1
46	Holder, Wear Pad (Wire rope deadend)	68044	1
47	Tie-Down Ring	32536	1
48			

FIGURE 21 BOOM ASSEMBLY (58,68) beginning with Serial # 4898*

REF	DESCRIPTION	PART NUMBER	QTY
49			
50			
51	Cable Clamp		4
52	Anchor Bracket Weldment	68083	4
53	Capscrew, Socket Hd. 1/2" - 20 UNC x 5/8" LG.		4
54	Capscrew, Flat Hd. Socket 1/4" - 20 UNC x 1" LG.		2
55	Wear Pad, Bottom	68034	4
56	Capscrew, Flat Hd. Socket 3/8" - 16 UNC x 5/8" LG.		8
57	Sheave, Retraction	68049	2
58	Zerk Fitting, STR 1/4" - 28 UNF (SAE-LT.)		4
59	Capscrew, Socket Hd. 1/4" - 20 UNC x 1" LG.		16
60	Wear Pad, Top	68033	1
61	Capscrew, Flat Hd. Socket, 3/8" - 24 UNF x 1/2" LG.		8
62	Capscrew, Socket Hd. 1/4" - 20 UNC x 1/2" LG.		4
63	Pin, Sheave	68050	4
64	Wear Pad, Top	68032	1
65	Sheave, Extension	68048	2
66	Capscrew, Flat Hd. Socket, 1/4" - 20 UNC x 1/2" LG.		4
67	Wear Pad - Ext. Cylinder, Top	68073	1
68	Wear Pad - Ext. Cyl.	68029	2
69	Pin, Extension Cylinder	21808	1
70	Wear Pad, Bracket Guide	68114	2
71	Lockwasher, 1/4"		14
*Except for #4901			

FIGURE 21A BOOM ASSEMBLY (48)

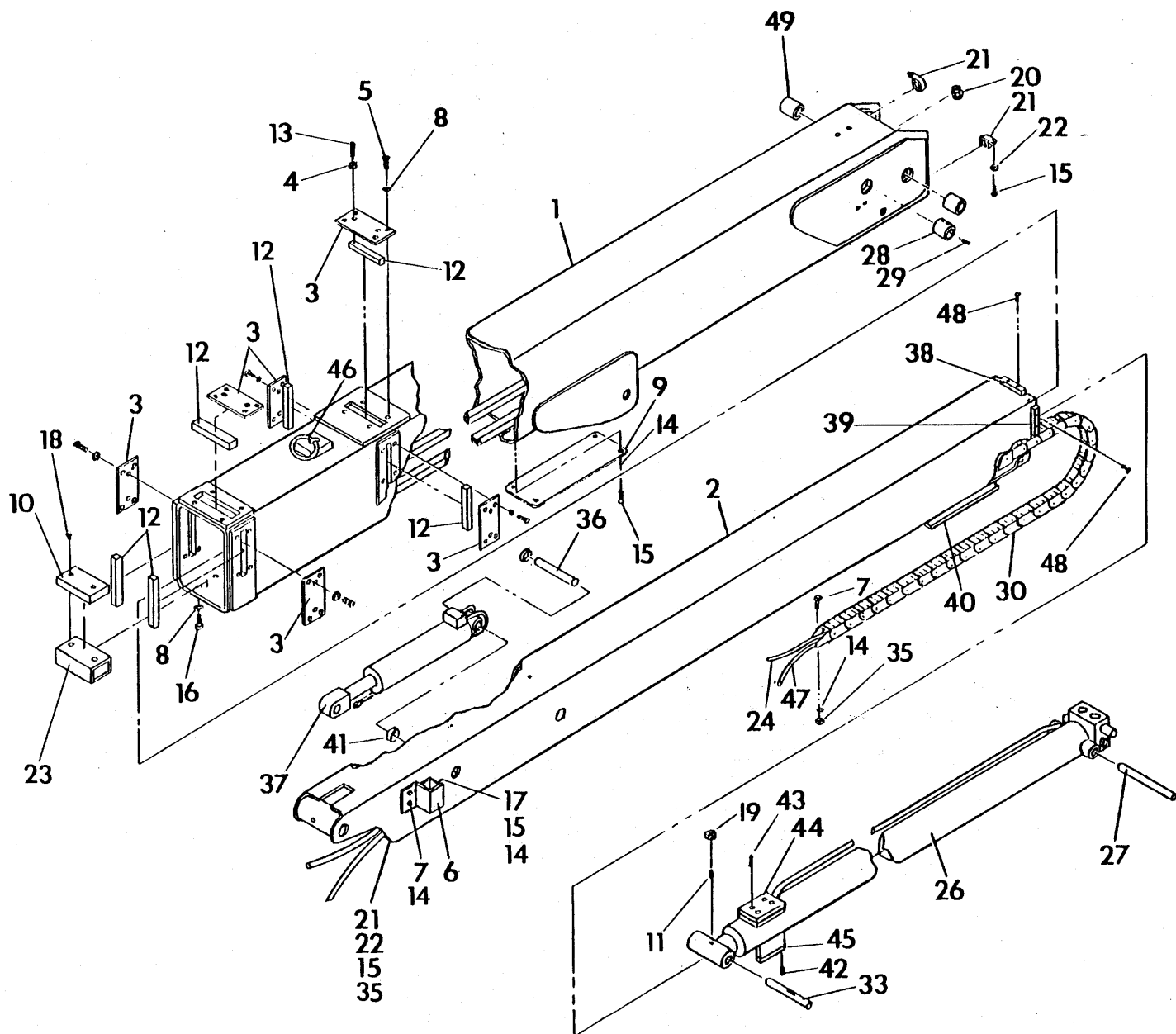


FIGURE 21A BOOM ASSEMBLY (48)

REF	DESCRIPTION	PART NUMBER	QTY
	Boom Assembly	40693	
1	Outer Boom Fabrication	40619	1
2	Inner Boom Fabrication	40622	1
3	Plate	32718	6
4	Jam Nut, Hex 1/2" - 20 UNF		12
5	Capscrew, Hex Head 3/8-16 UNC x 1" LG.		24
6	Limit Switch Cover	40548	1
7	Capscrew, Hex Head 1/4"-20 N.C. x 3/4" LG.		6
8	Lock Washer, 3/8"		26
9	Cover Plate	32608	1
10	Wear Pad, Bottom	32602	1
11	Socket Head Set Screw		
	Full Dog Point 1/2 - 13 UNC x 1-1/4 LG.		1
12	Wear Pad, Top	32717	6
13	Set Screw		
	Oval Point 1/2" - 20 UNF x 3/4" LG.		12
14	Lockwasher, 1/4"		12
15	Capscrew, Hex Head 1/4" - 20 x 1/2" LG.		10
16	Capscrew, Hex Head 3/8 - 16 x 3/4 LG.		2
17	Limit Switch	40208	1
18	Flat Head Socket Screw		
	3/8" - 16 UNC x 1" LG.		2
19	Hex Jam Nut 1/2 - 13 UNC		1
20	Adapter, Bulkhead	2041-6-6	2
21	Loom Clamp 1/4" x 1 Bowman		4
22	Washer, Flat 1/4"		4
23	Mount-Wear Pad Front	32607	1
24	Hydraulic Hose	80143-2	1
25	Electric Cable	40785	1
26	Boom Extension Cylinder	32622	1
27	Pin, Main Boom- Extension Cylinder	32168	1
28	Eccentric, Boom	32143	2
29	Set Screw, Allen Head 3/8-24 UNCx1/2 LG.		
30	Plastitrak Type 1023 51 pcs.	32603-4	1
31	Bushing, Boom Pivot Pin	40620	2
32	Capscrew, Flat Head #1032 x 3/8 LG.		6
33	Pin, Inner Boom	32630	1
34	Tie Down Ring	32563	1
35	Nut, Hex 1/4" - 20 N.C.		8
36	Pin, Leveling Cylinder	32629	1
37	Slave Leveling Cylinder Assembly	40790	1
38	Wear Pad	32715	1
39	Wear Pad	32716	2
40	Wear Pad	32628	2
41	Bushings	40803	2

FIGURE 21A BOOM ASSEMBLY (48)

REF	DESCRIPTION	PART NUMBER	QTY
42	Capscrew 82° Flat Head Socket 1/4" -20 x 1-1/2" LG.		4
43	Capscrew 82° Flat Head Socket 1/4" -20 N.C. x 3/4" LG.		4
44	Wear Pad	32624	1
45	Wear Pad	32623	2

FIGURE 21B BOOM ASSEMBLY (50 - Two Cable System) Beginning with Ser. #4820

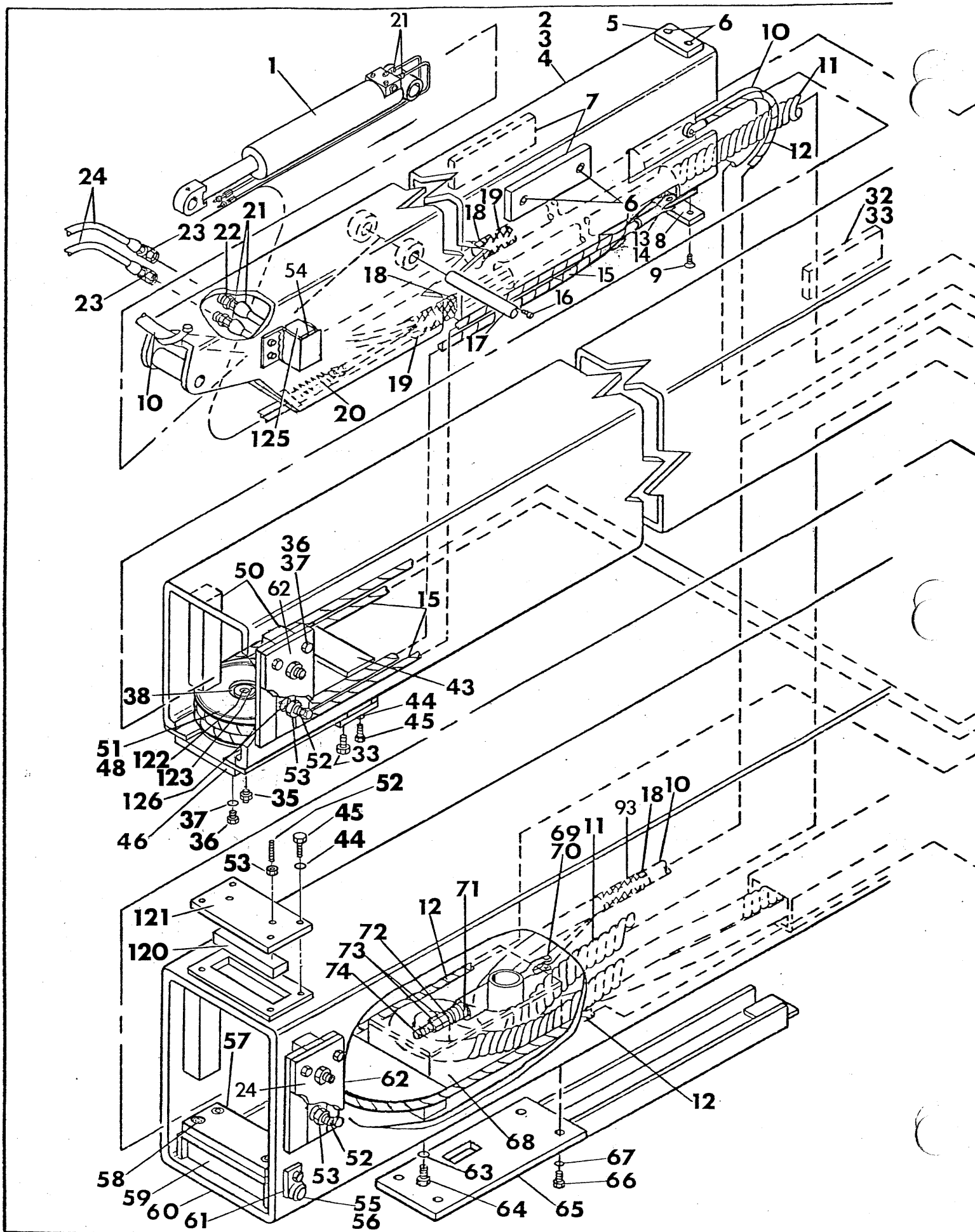
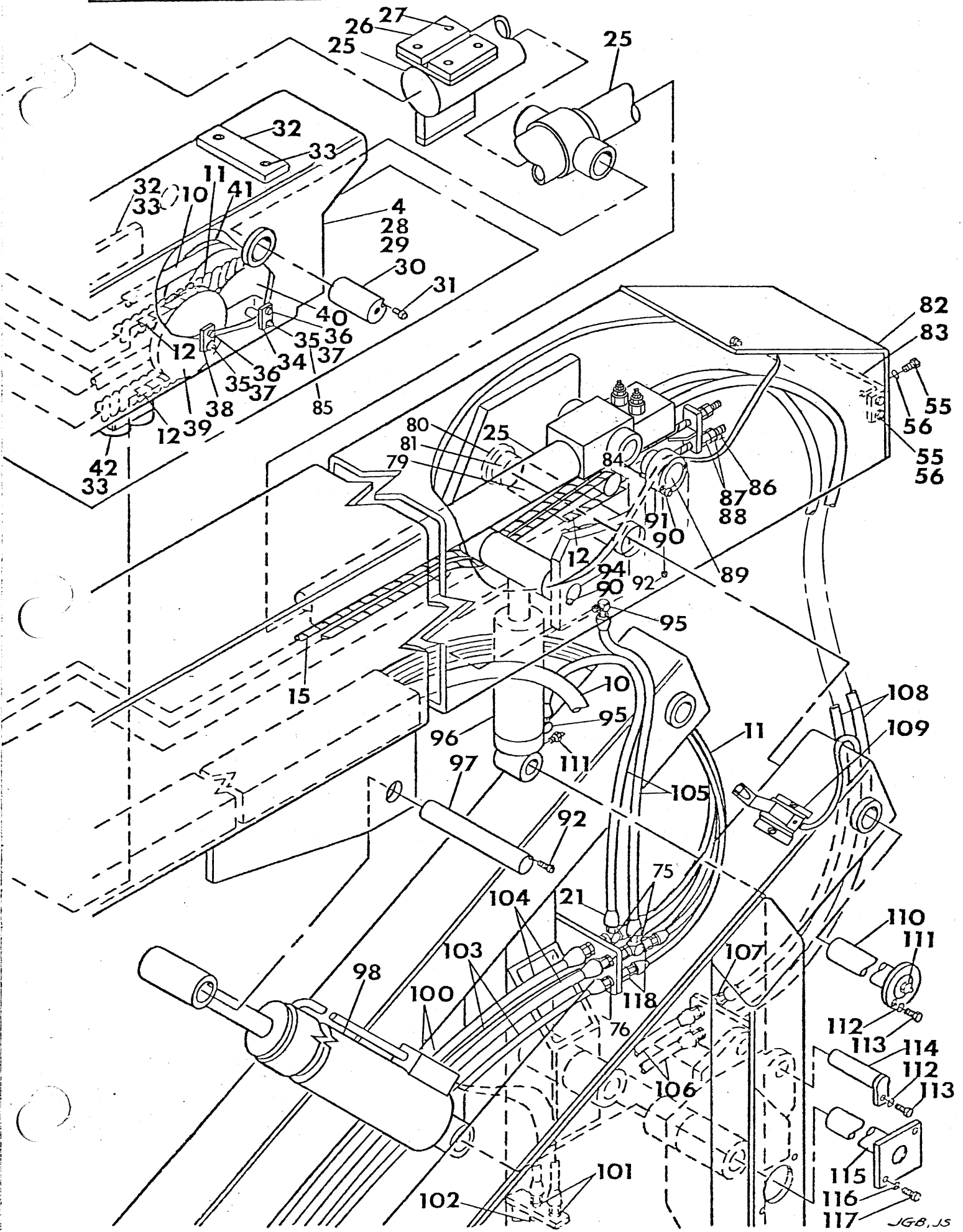


FIGURE 21B BOOM ASSEMBLY (50 - Two Cable System) Beginning with Ser. #4820



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FIGURE 21B BOOM ASSEMBLY (50 - Two Cable System) Beginning with Ser. #4820

REF	DESCRIPTION	PART NUMBER	QTY
21-	Boom Assembly	40853	1
1	Slave Leveling Cylinder Assembly	40790	1
2	Inner Boom Assembly	40741	1
3	Inner Boom Weldment	40740	1
4	Inner to Intermediate Boom Assembly	40719	1
5	Wear Pad	21775	1
6	Allen Flat Head Socket Machine Screw	3/8 - 24 UNF x 3/4	6
7	Wear Pad	21787	2
8	Wear Pad	21822	1
9	Allen Flat Head Socket Machine Screw	3/8 - 24 UNF x 1	2
10	Electrical Cable Assembly	40812	1
11	Hydraulic Hoses Assembly	21818	1
12	Retraction Cable Assembly	21820	1
13	Clevis Pin	1/2 x 1-1/4	3
14	Cotter Pin	1/8 x 1	3
15	Extension Cable Assembly	21819	2
16	Allen Head Set Screw	3/8 - 16 UNC x 3/8	1
17	Leveling Cylinder Pin	21896	1
18	Punch Lock Clamp	1-1/4	3
19	Support Grip	022-11-003	2
20	Spring	21489	1
21	Adaptor, #4 JIC x 1/8" MP		2
22	Bulkhead Union Adapter		2
23	Elbow, 90° - #6 JIC x # JIC F. Swivel		2
24	Plate Wear Pad, Adj.	40537	2
25	Boom Extension Cylinder Assembly	(See Fig. 25)	1
26	Wear Pad	21802	2
27	Allen Flat Head Socket Machine Screw	10-32 UNF x 3/4	4
28	Intermediate Boom Assembly	40718	1
29	Intermediate Boom Weldment	40738	1
30	Trunion Pin	21810	2
31	Allen Head Set Screw	3/8 - 24 UNC x 3/4	2
32	Wear Pad	21787	3
33	Allen Flathead Socket Machine Screw	3/8 - 24 UNC x 1	10
34	Sheave Pin	21785	1
35	Lube Fitting	1/4 NPT	3
36	Hex Head Capscrew, 1/2"-13 UNC x 3/4" LG.		11
37	Lockwasher, 1/2"		11
38	Bushing, Bronze	40931	1
39	Extension Cable Sheave	21774	1
40	Hydraulic Hoses Assembly Sheave	21784	1
41	Electric Cable Sheave	21783	1
42	Wear Pad	21772	2
43	Wear Pad	21807	1
44	Lockwasher, 3/8"	3/8"	8
45	Hex Head Capscrew, 3/8" -24UNF x 3/4" LG.	3/8"	8

FIGURE 21B BOOM ASSEMBLY (50 - Two Cable System) Beginning with Ser. #4820

REF	DESCRIPTION	PART NUMBER	QTY
46	Bracket	40209	1
47	Retainer Plate	40932	1
48	Cable Sheave and Bracket Assembly	40934	1
49	Retainer	40214	1
50	Wear Pad	21812	4
51	Sheave	40933	1
52	Set Screw	1/2 - 20 UNF x 3/4	10
53	Jam Nut	1/2 - 20 UNF	10
54	Limit Switch Bracket	40548	1
55	Hex Head Capscrew	1/4 - 28 UNF x 1/2	22
56	Lockwasher	1/4	22
57	Wear Pad	21805	1
58	Allen Flat Head Socket	3/8 - 24 UNF x 1	4
59	Wear Pad Bracket	21804	1
60	Outer Boom Weldment	40742	1
61	Bracket Shaft	21806	1
62	Back-Up Plate	21813	2
63	Lockwasher	5/8	2
64	Hex Head Capscrew	5/8 x 11 UNC x 1-1/2 (Grade 5)	2
65	Hose Cover Guard	21788	1
66	Hex Head Capscrew	3/8 - 24 UNF x 3/4	4
67	Lockwasher	3/8	4
68	Turn-Around Bracket	21706	1
69	Clevis Pin	C7	1
70	Cotter Pin	1/8 x 1	1
71	Pressure Spring	21488	1
72	Flat Washer	7/16 I.D. x 10.D (Type A)	1
73	Hex Head Nut	3/8 - 24 UNF	2
74	Threaded Rod Assembly	21861	1
75	Tee, Bulkhead #6 JIC		2
76	Adapter, Bulkhead #6 JIC		2
77	Limit Switch	40208 (50)	1
78	Washer	32570 15/16 x 7/32	1
79	Tube Spacer	21040-2	1
80	Washer	4-1/2 O.D. x 2-1/4 I.D.	A/R
81	Pivot Pin Bushing	21773 (50)	2
82	Outer Boom Rear Cover	21755 (50)	1
83	Rear Cover Brace	21754 (50)	1
84	Socket Set Screw	5/16 - 18 UNC x 1	4
85	Spacer	3/4 x 1-1/4 B.P.	1
86	Cotter Pin	1/8 x 1-1/2	2
87	Hex Nut	3/4 - 10 UNC	4
88	Internal Tooth Lockwasher	3/4	2
89	Boom Extension Cylinder Pin	21808 (50)	1
90	Socket Head Cap Screw	3/8 - 24 UNC x 1/2	3

FIGURE 21B BOOM ASSEMBLY (50 - Two Cable System) Beginning with Ser. #4820

REF	DESCRIPTION	PART NUMBER	QTY
91	Eccentric	21809 (50)	2
92	Socket Head Cap Screw	3/8 - 24 UNC x 1	3
93	Support Grip	022-01-1467	1
94	Master Leveling Pin	21847 (50)	1
95	Elbow, 90° - #4 JIC x 7/16" - 20 O-Ring		2
96	Master Leveling Cylinder (See Fig. 24)	40003 (50)	1
97	Topping Cylinder Boom Pin	21845 (50)	1
98	Topping Cylinder Assembly	(See Fig. 27)	1
99	Elbow, 90° 1 #6 JIC x 9/16" - 18 O-Ring		2
100	Hose Assembly	FG 1012-GGG-0217	2
101	Adapter, Bulkhead - #6 JIC		2
102	Hose Assembly -To Turret Solenoid Control Valve Pack	FG 1005-GGG-0430	2
103	Hose Assembly -To Turret Solenoid Control Valve Pack	FA 7229-GGG-0730	2
104	Hose Assembly -To Turret Holding Valve	FG 101-GGG-0610	2
105	Hose Assembly	FC120-EBE-0660	2
106	Hose Assembly -To Turret Proportional Control Valve Pack	FG 1011-HHH-0660	2
107	Elbow, Bulkhead - 90° - #8 JIC		2
108	Hose Assembly	FG 1011-HHJ-0350	2
109	Limit Switch**	40207 (50)	1
110	Boom To Turret Pivot Pin	21791 (50)	1
111	Lube Fitting	1/8 NPT	3
112	Lockwasher	3/8	3
113	Hex Head Cap Screw	3/8-24 UNC x 1/2	3
114	Master Leveling Cylinder Pin	21131 (50)	1
115	Topping Cylinder Pin	21645 (50)	1
116	Lockwasher	5/16	2
117	Hex Head Cap Screw	5/16-18 UNC x 3/4	2
118	Tube End Reducer		4
119	Capscrew, Hex Hd. 3/8" - 16 UNC x 5/8" Lg.		4
120	Wear Pad	40717	1
121	Plate, Wear Pad	40718	1
122	Flat Head Socket Screw, 3/8" - 16 UNC x 3/4" Lg.		1
123	Spirol Pin, 1/8" x 3/4" Lg.		1
** Part of Automatic Shift to low gear system - (See Figure 4A)			

FIGURE 23 SLAVE LEVELING CYLINDER ASSEMBLY (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
1	Slave Leveling Cylinder	40617	1
2	O -Ring Adapter	2404-4-4	2
3	Grease Fitting (Zerk) 1/4 - 28 UNF		1
4	Tube Assembly	32611-1	2

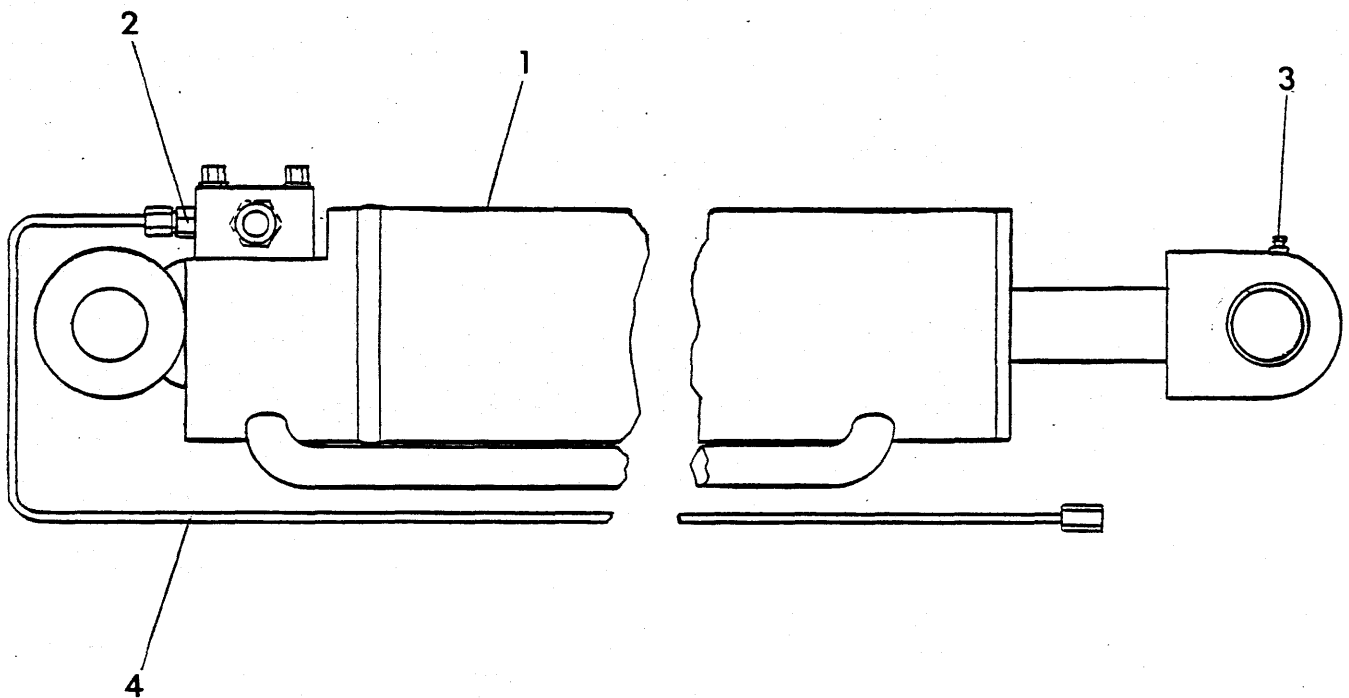


FIGURE 23A SLAVE LEVELING CYLINDER, PARTS BREAKDOWN (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
	Slave Cylinder	40617	1
1	Lock nut, Self-Locking	92027	1
2	Piston	92024	1
3	Gland	92023	1
4	Rod Assembly	92026	1
5	Barrel Assembly	92025	1
6	Bushing, Bronze	92028	1
7	Socket Head Screw 1/4-20 UNC	92029	3
8	Dual P.O. Check Valve	40708	1
9 *	Rod Wiper	*	1
10*	Rod Seal	*	1
11*	Rod Static Seal	*	1
12	Washer	92030	
13*	Gland Static Seal	*	1
14*	Piston Seal	*	2
15	Lockwasher	92031	3
*	Seal Kit (Contains Items 9, 10, 11, 13, 14)	40684	

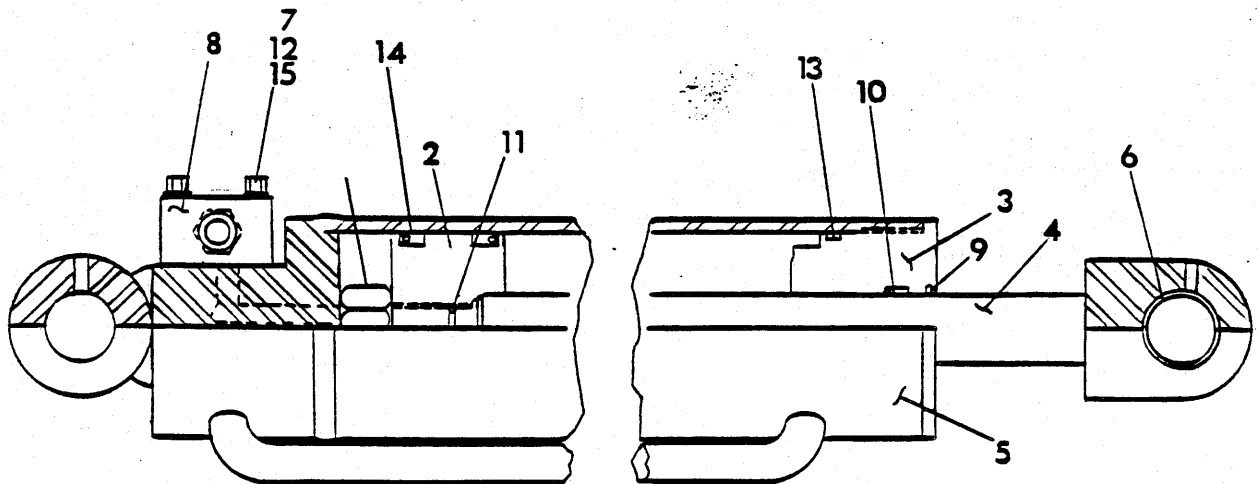
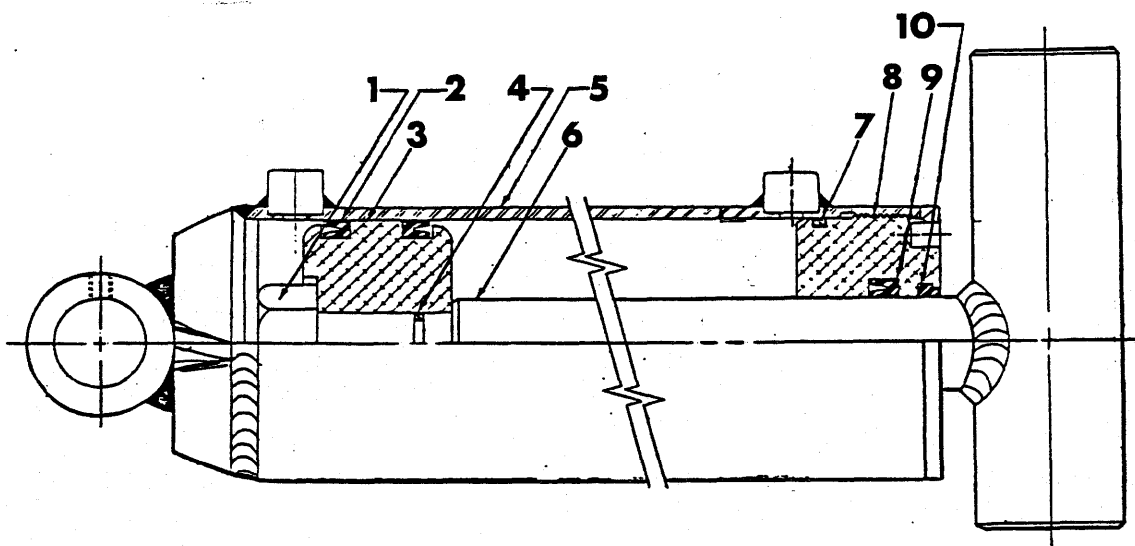


FIGURE 24 - MASTER LEVELING CYLINDER (ALL MODELS)



REF	DESCRIPTION	PART NUMBER	QTY
24-	Master Leveling Cylinder (L)	40003	1
1	Locknut - Self-Locking	92027	1
2	Piston Seal - U-Cup	*	2
3	Piston	92032	1
4	Rod Static Seal	*	1
5	Barrel Assembly	92033	1
6	Rod Assembly	92034	1
7	Gland Static Seal	*	1
8	Gland	92023	1
9	Rod Seal	*	1
10	Rod Wiper	*	1
11*	Seal Kit (Contains Items 2,4,7,9,10)	40684	1

FIGURE 25 BOOM EXTENSION CYLINDER ASSEMBLY (50)

REF	DESCRIPTION	PART NUMBER	QTY
25-	Boom Extension Cylinder Assembly	40043 (50)	1
-1	Boom Extension Cylinder	40771 (See Fig. 26B, C, or D)	1
-2	Wear Pad	21801	1
-3	Flat Head Socket Machine Screw	#10-32 UNF x 1	2
-4	Flat Head Socket Machine Screw	#10-32 UNF x 3/4	4
-5	Wear Pad	21802	2

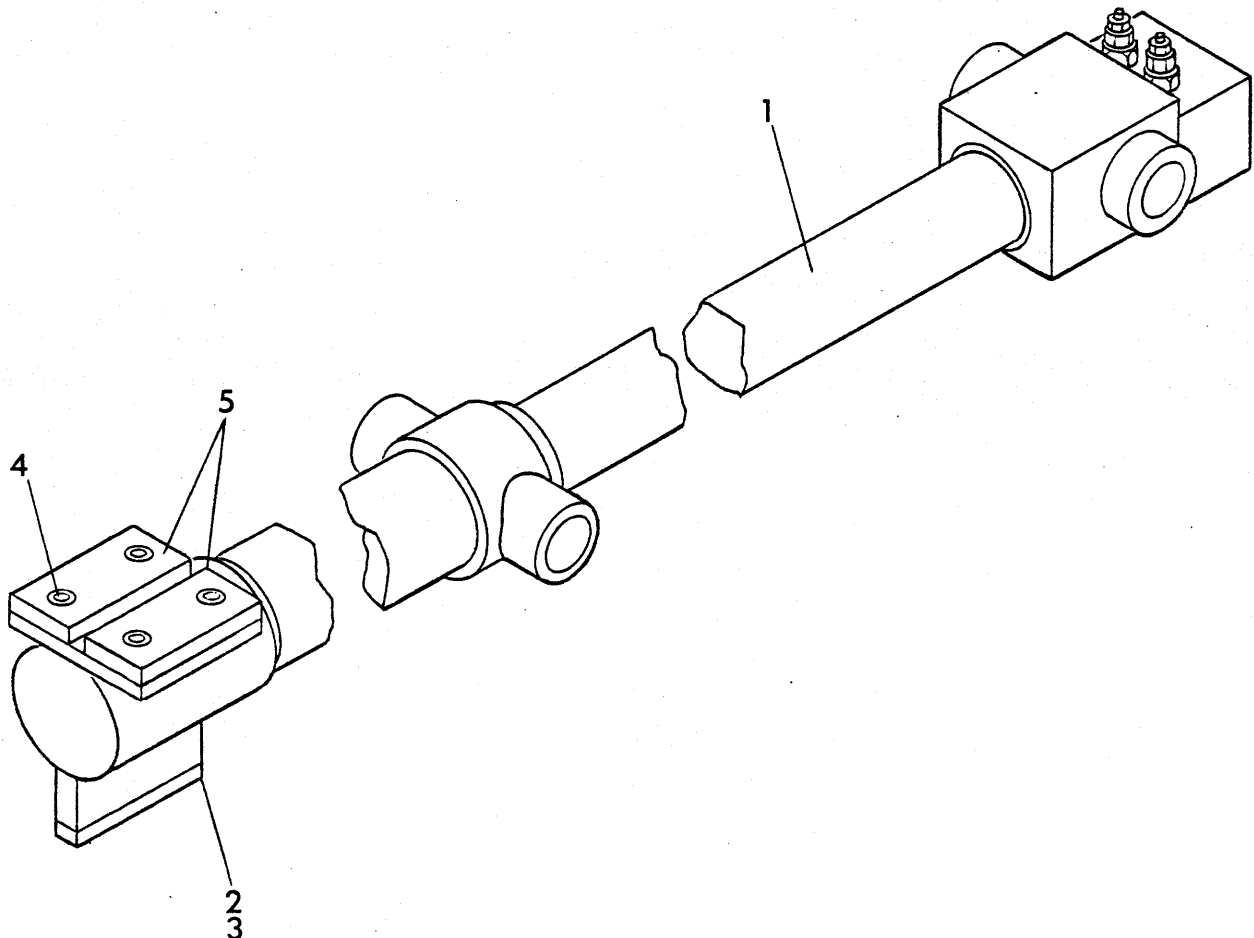


FIGURE 25A - BOOM EXTENSION CYLINDER (50)

REF	DESCRIPTION	PART NUMBER	QTY
25A	Boom Extension Cylinder	40771	1
1	Rod Assembly	92058	1
2	Barrel	92059	1
3	Head	92060	1
4	Piston	92051	1
5	Stop Tube	92052	1
6	Dual CounterBalance Valve	40817	1
7	Holding Valve Cartridge	32585	2
8	Piston-Rod Static O-Ring	*	1
9	Head Static O-Ring	*	1
10	Head Back Up Ring	*	1
11	Piston Seal	*	2
12	Head Rod Seal	*	1
13	Std. Rod Wiper	*	1
14	Relief Valve Cartridge	32586	1
*	Seal Kit (Contains Items 8-13)	40883	1

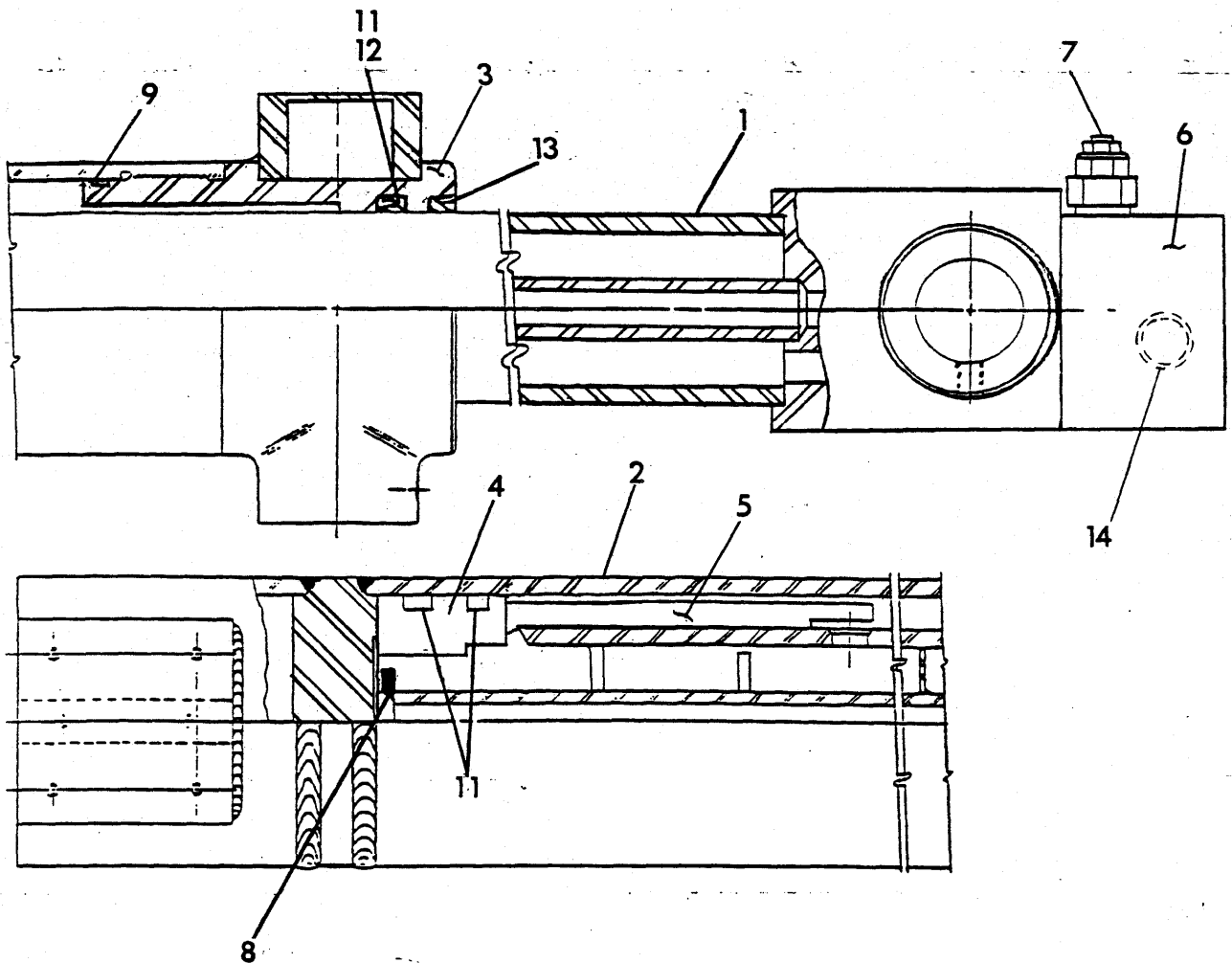


FIGURE 26 BOOM EXTENSION CYLINDER ASSEMBLY (48)

REF	DESCRIPTION	PART NUMBER	QTY
1	Extension Cylinder Assembly	32622	1
2	Set Screw, Allen Head	1/2 - 13 UNC.	1
3	Screw, Socket, Flat Head	1/4-20 UNC x 1-1/2 LG.	4
4	Wear Pad	32623	2
5	Wear Pad	32624	1
6	Screw, Socket, Flat Head	1/4-20 UNC 3/4 LG.	4
7	Cylinder	40770	1

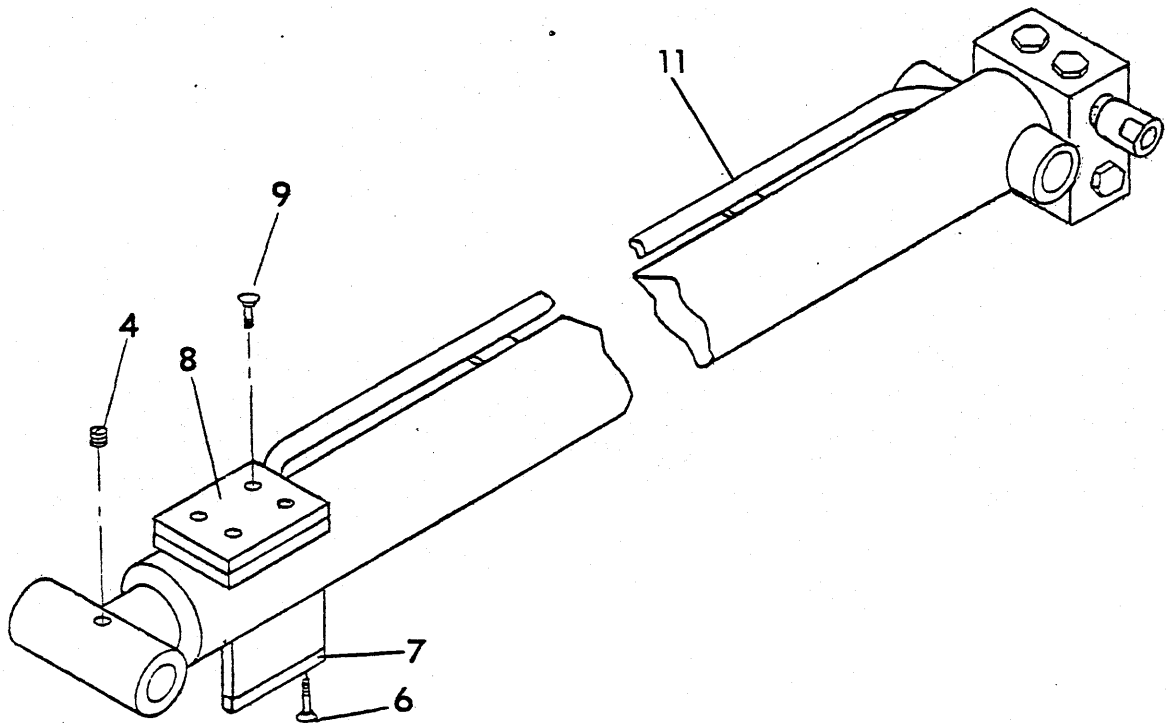


FIGURE 26A BOOM EXT. CYLINDER PARTS BREAKDOWN (48)

REF	DESCRIPTION	PART NUMBER	QTY
26A	Cylinder	40770	
1	Head	92061	1
2	Piston	92062	1
3	Barrel	92063	1
4	Rod	92064	1
5	Stop Tube	92065	1
6	Holding Valve Cartridge	32585	2
7	Dual Counter Balance Valve	40817	1
8	Piston-Rod Static O-Ring	*	1
9	Head Static O-Ring	*	1
10	Head Back Up Ring	*	1
11	Piston Seal	*	3
12	Piston Seal Expander Ring	*	3
13	Head Rod Seal	*	1
14	Std. Rod Wiper	*	1
15	Relief Valve Cartridge	32586	1
*	Seal Kit (Contains Items 8-14)	40882	1

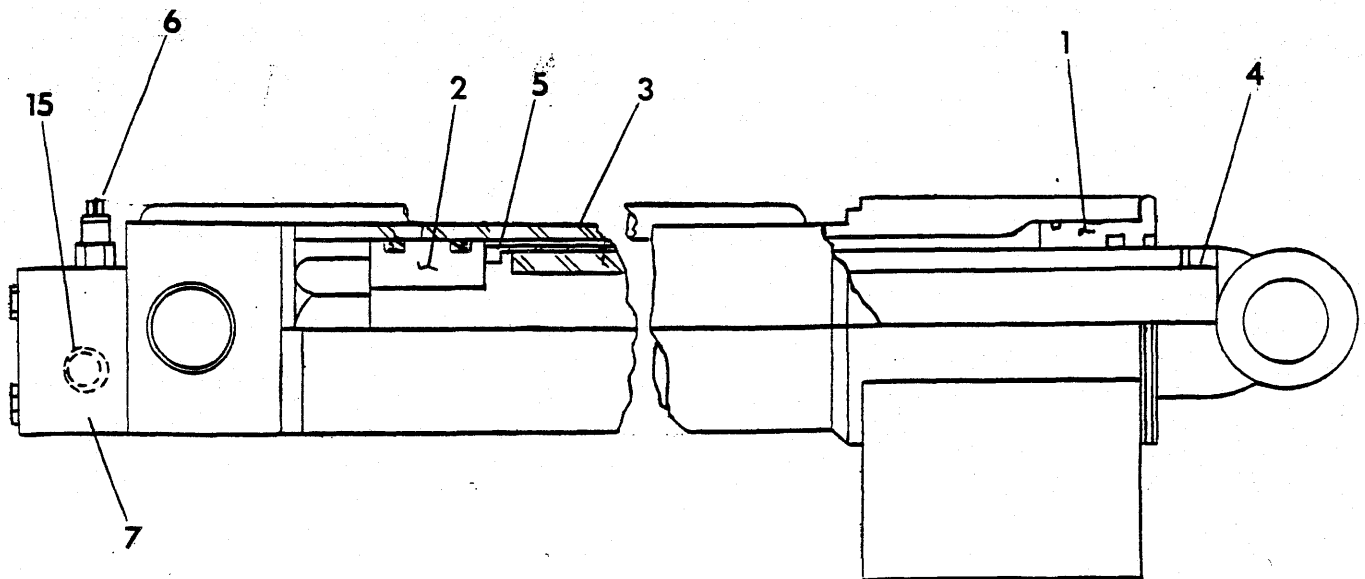


FIGURE 26 B BOOM EXTENSION ASSEMBLY (58)

REF	DESCRIPTION	PART NUMBER	QTY
1	Extension Cylinder	40772	1
2	Wear Pad-Bottom	68029	2
3	Wear Pad-Top	68073	1
4	Screw Socket Head Cap	1/4-20 UNCx1/2 LG	4
5	Screw Flat Head Socket	1/4-20 UNCx1/2 LG	4

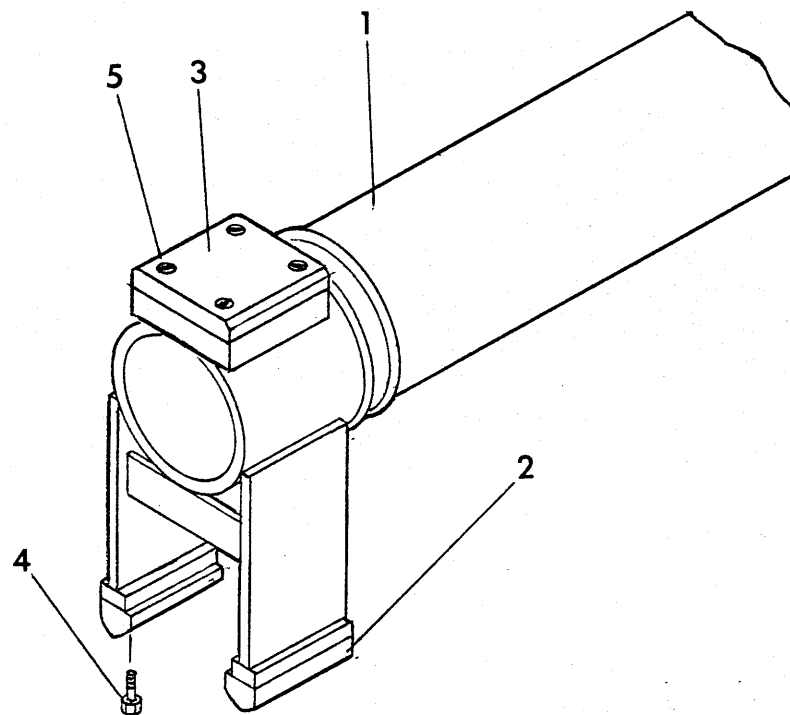


FIGURE 26C - BOOM EXTENSION CYLINDER (58)

REF	DESCRIPTION	PART NUMBER	QTY
26C	Boom Extension Cylinder	40772	
1	Rod Assembly	92048	1
2	Barrel	92049	1
3	Head	92050	1
4	Piston	92051	1
5	Stop Tube	92052	1
6	Dual CounterBalance Valve	40817	1
7	Holding Valve Cartridge	32585	2
8	Piston-Rod Static O-Ring	*	1
9	Head Static O-Ring	*	1
10	Head Back Up Ring	*	1
11	Piston Seal	*	2
12	Head - Rod Seal	*	1
13	St. Rod Wiper	*	1
14	Relief Valve Cartridge	32586	1
*	Seal Kit (Contains Items 8-13)	40883	1

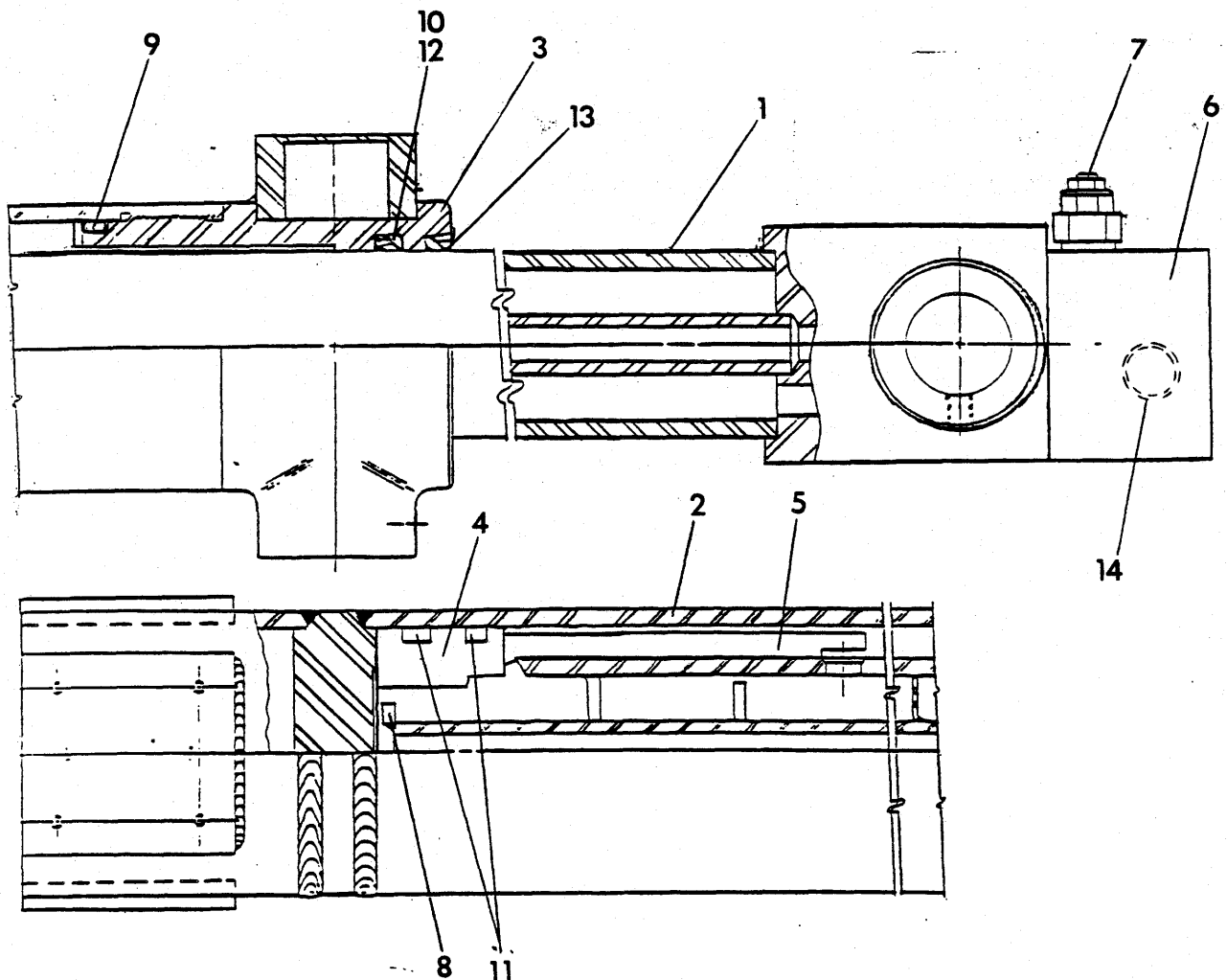


FIGURE 26 D BOOM EXTENSION ASSEMBLY (68)

REF	DESCRIPTION	PART NUMBER	QTY
1	Extension Cylinder	40773	1
2	Wear Pad-Extension Cylinder	68029	2
3	Wear Pad-Extension Cylinder-Top	68073	1
4	Socked Head Cap Screw	1/4-20 UNCx1/2 LG	4
5	Flat Head Socket Screw	1/4-20 UNCx1/2 LG	4

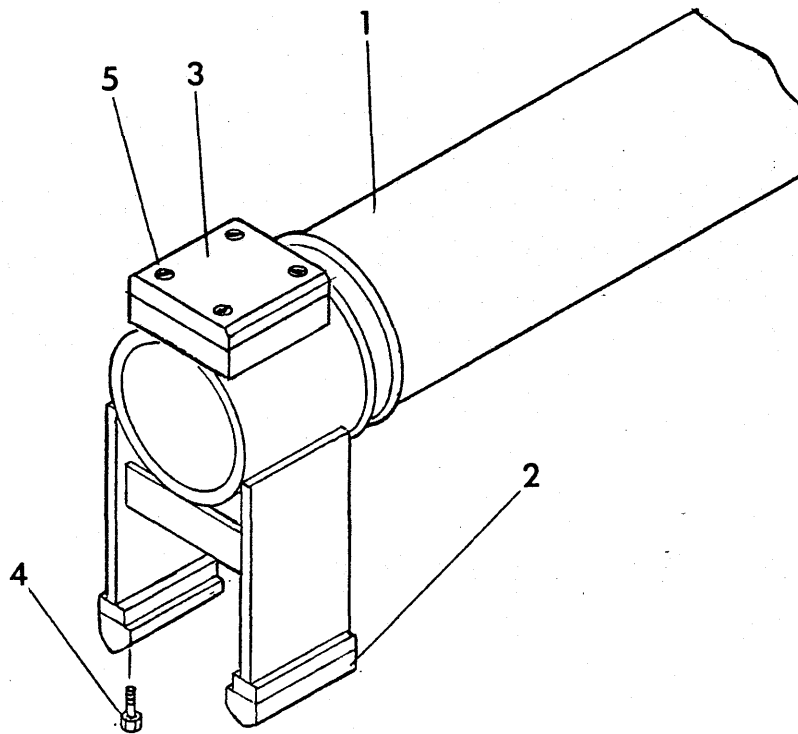


FIGURE 26E - BOOM EXTENSION CYLINDER (68)

REF	DESCRIPTION	PART NUMBER	QTY
26E	Boom Extension Cylinder	40773	1
1	Rod Assembly	92053	1
2	Barrel	92054	1
3	Head	92055	1
4	Piston	92056	1
5	Stop Tube	92057	1
6	Dual CounterBalance Valve	40817	1
7	Holding Valve Cartridge	32585	2
8	Piston-Rod Static O-Ring	*	1
9	Head Static O-Ring	*	1
10	Head Back Up Ring	*	1
11	Piston Seal	*	2
12	Head-Rod Seal	*	1
13	St. Rod Wiper	*	1
14	Relief Valve Cartridge	32586	1
*	Seal Kit (Contains Items 8-13)	40884	1

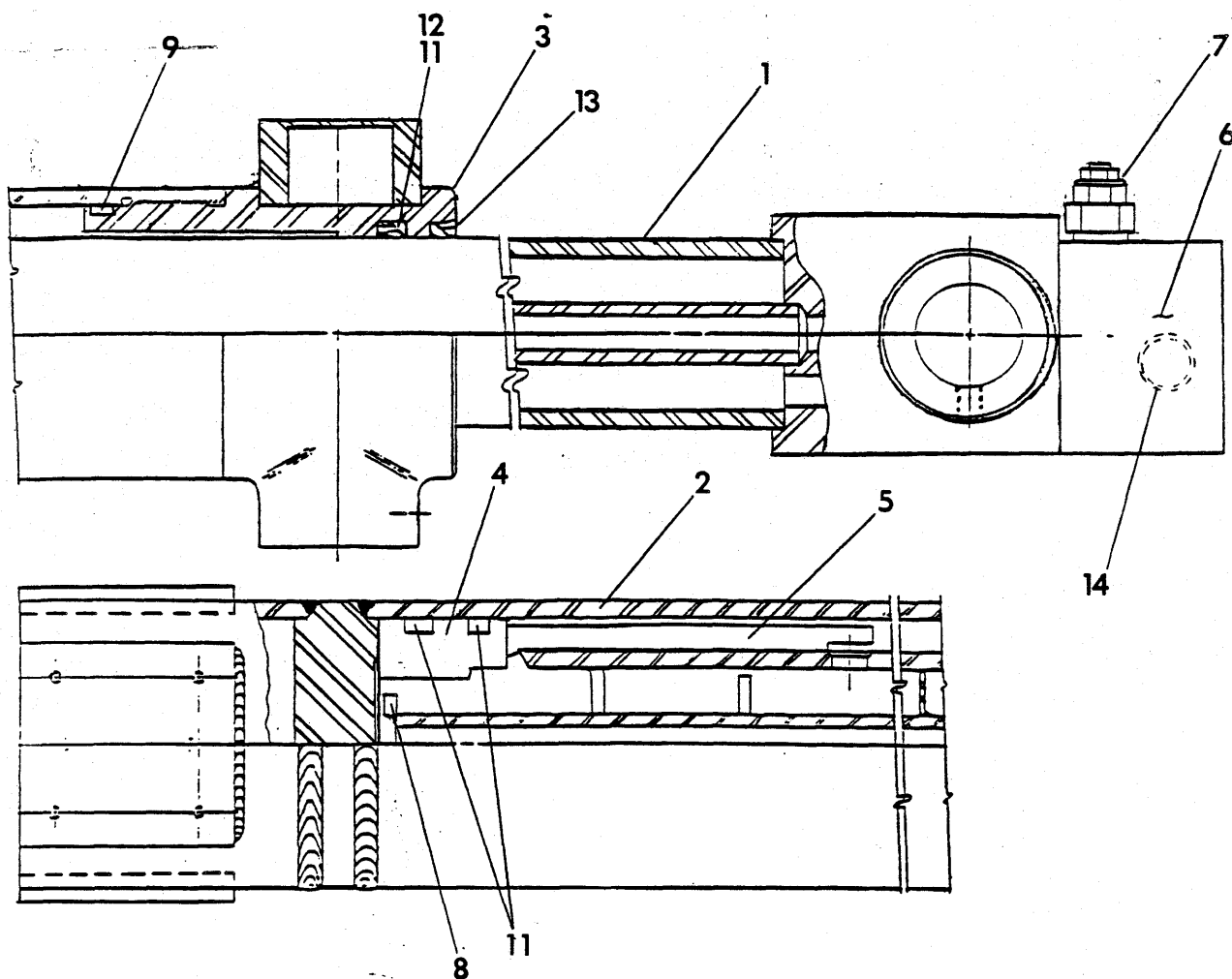


FIGURE 28 TOPPING CYLINDER PARTS BREAKDOWN 48

REF	DESCRIPTION	PART NUMBER	QTY
	Topping Cylinder	40610	1
1	Manifold Pipe Assembly	92000	1
2	Bronze Bushing	92001	1
3	Piston	92013	4
4	Spacer	92003	1
5	Gland	92014	1
6	Rod Assembly	92015	1
7	Single C'Balance Valve Assembly	40707	1
8	Barrel Assembly	92016	1
9	Hex Nut	92007	1
10	Collar	92017	1
11	Bolt	92009	2
12	Washer	92010	2
13	Lockwasher	92011	2
14	Set Screw w/Nylon Insert	92012	1
15*	Rod Seal	*	1
16*	Rod Wiper	*	1
17*	Gland Static Seal	*	1
18*	Piston Seal	*	2
19*	Rod Static Seal	*	1
20	Holding Valve Cartridge	32586	1
*	Seal Kit (Contains Items 15-19)	40685	

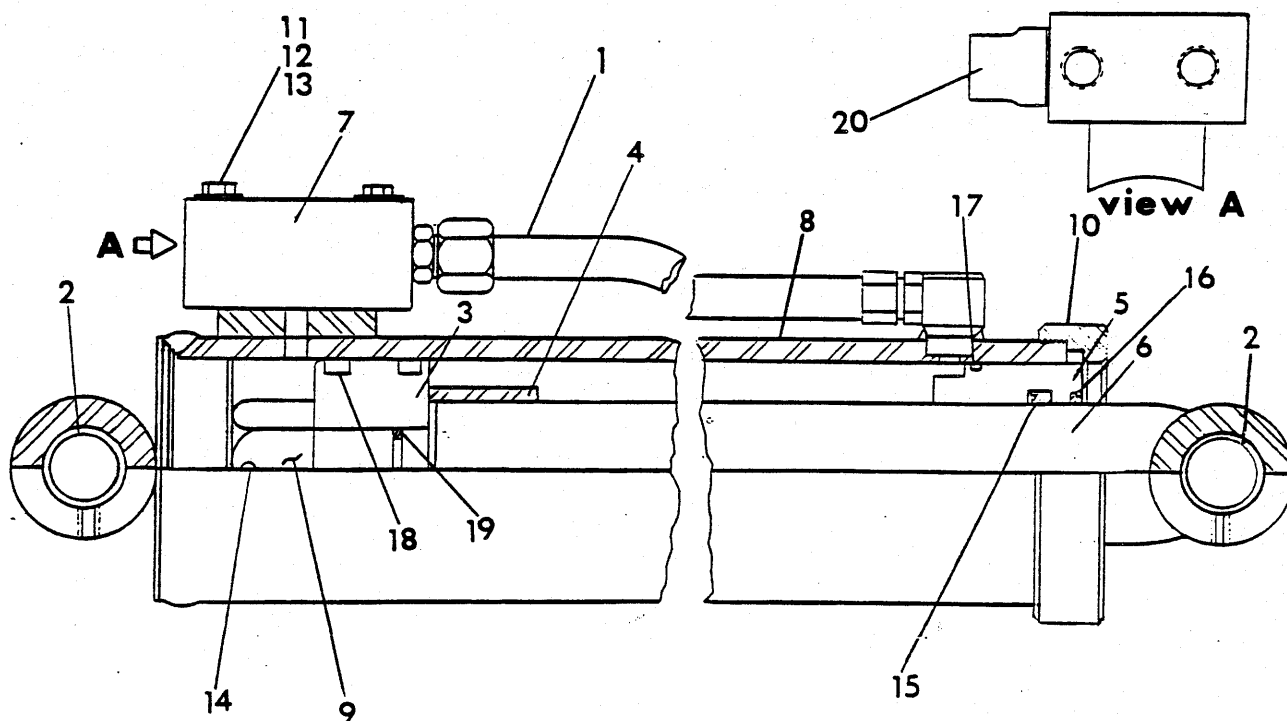


FIGURE 28A TOPPING CYLINDER, PARTS BREAKDOWN

50

REF	DESCRIPTION	PART NUMBER	QTY
	Topping Cylinder	40611	1
1	Manifold	92000	1
2	Bronze Bushing	92001	4
3	Piston	92002	1
4	Spacer	92003	1
5	Gland	92004	1
6	Rod Assembly	92005	1
7	Single C'Balance Valve Assembly	40707	1
8	Barrel Assembly	92006	1
9	Hex Nut	92007	1
10	Collar	92008	1
11	Bolt 3/8-24	92009	2
12	Washer	92010	2
13	Lockwasher	92011	2
14	Set Screw w/Nylon Insert	92012	1
15*	Rod Seal	*	1
16*	Rod Wiper	*	1
17*	Gland Static Seal	*	1
18*	Piston Seal	*	2
19*	Rod Static Seal	*	1
20	Holding Valve Cartridge	32586	1
*	Seal Kit (Contains Items 15-19)	40886	1

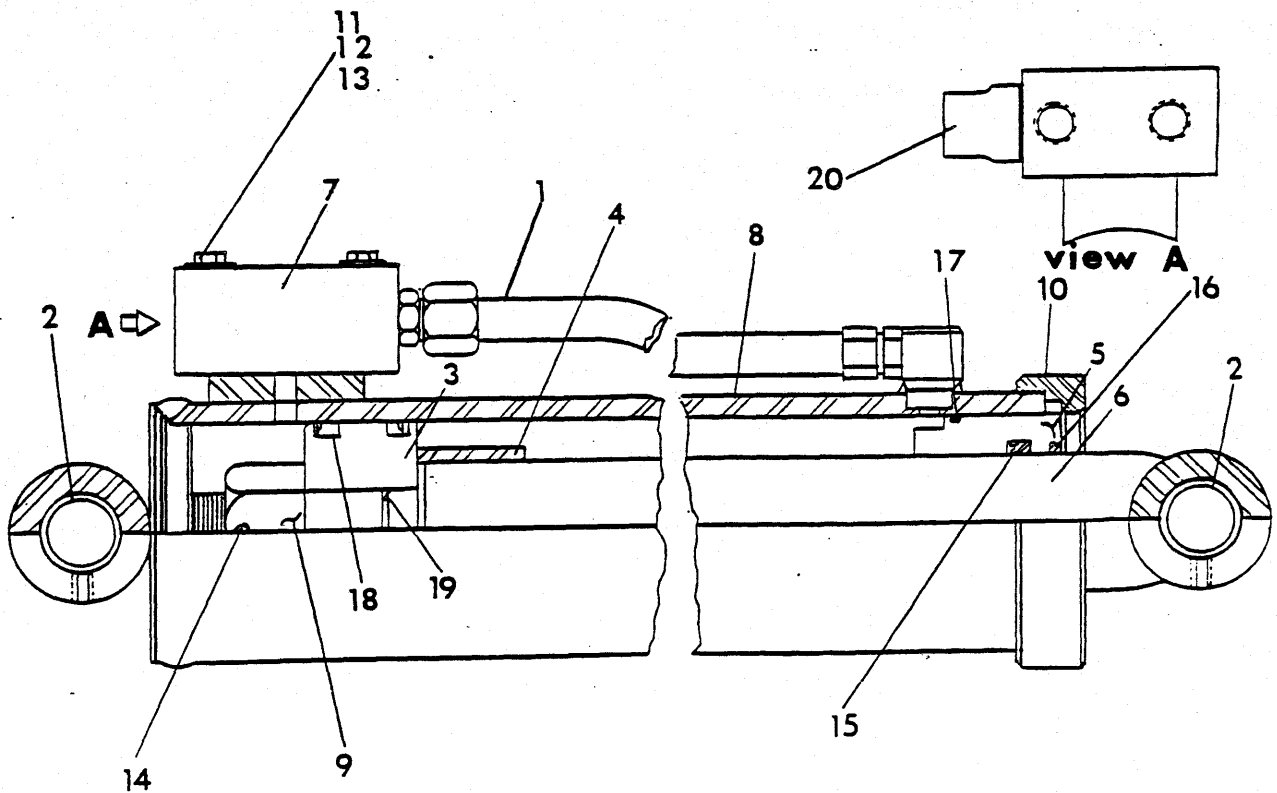


FIGURE 28 B TOPPING CYLINDER, PARTS BREAKDOWN (58,68)

REF	DESCRIPTION	PART NUMBER	QTY
	Topping Cylinder	40612	1
1	Manifold Assembly	92000	1
2	Bronze Bushing	92001	4
3	Piston	92018	1
4	Spacer	92020	1
5	Gland	92019	1
6	Rod Assembly	92022	1
7	Single C'Balance Valve Assembly	40707	1
8	Barrel Assembly	92021	1
9	Hex Nut	92007	1
10	Holding Valve Cartridge	32586	1
11	Bolt	92009	2
12	Washer	92010	2
13	Lockwasher	92011	2
14	Set Screw w/Nylon Insert	92012	1
15 *	Rod Seal	*	1
16*	Rod Wiper	*	1
17*	Gland Static Seal	*	1
18*	Piston Seal	*	2
19*	Rod Static Seal	*	1
*	Seal Kit (Contains Items 15-19)	40689	

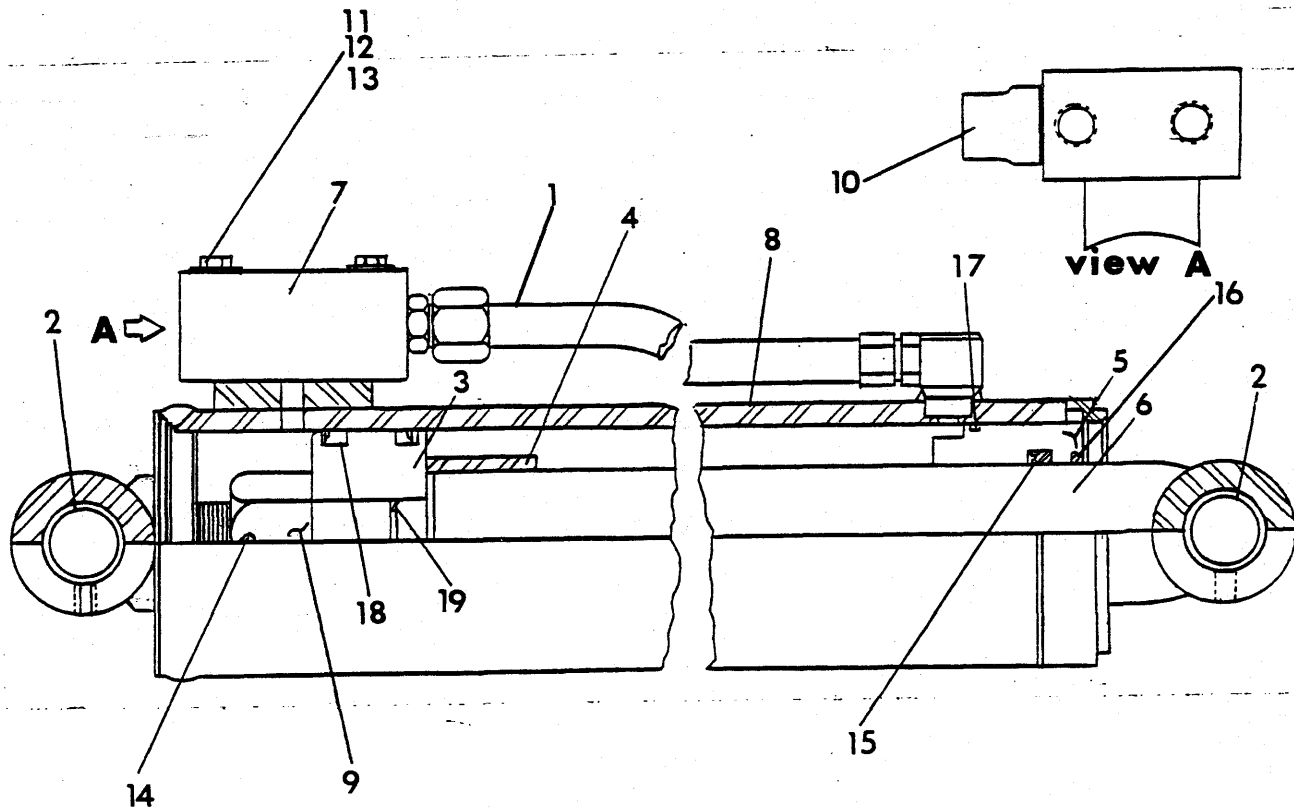


FIGURE 29 PLATFORM ASSEMBLY - NON-ROTATION

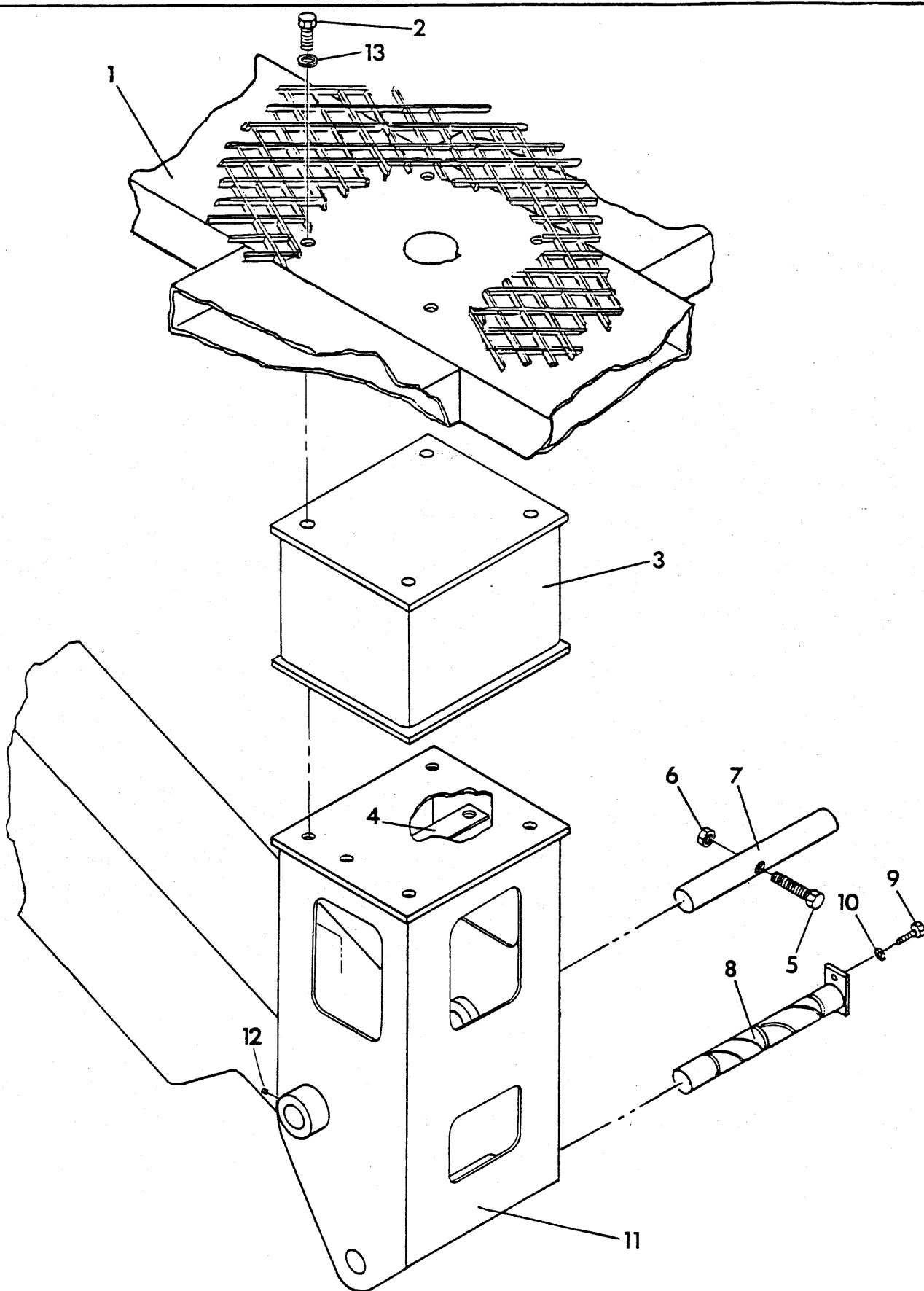


FIGURE 29 PLATFORM ASSEMBLY- NON-ROTATION

REF	DESCRIPTION	PART NUMBER	QTY
1	Platform Weldment	32723	1
2	Capscrew, 1/2" -13 UNC x 3 1/2" LG.		4
3	Spacer	32712	1
4	Lock Skirt-1" x 6 1/8" 16 GA.		1
5	Capscrew 3/8"-16 UNC x 3 1/2" LG.		1
6	Locknut, 3/8"-16 UNC		1
7	Pin, Boom to Skirt	32634	1
8	Pin, Main Leveling Skirt	21126	1
9	Capscrew, Hex Head, 1/4"- 20 UNC x 1/2" LG.		1
10	Lockwasher, 1/4"		1
11	Skirt	32711	1
12	Lube Fitting (Zerk) 1/8" NPT		2
13	Lockwasher, 1/2"		4
14	Capscrew, 1/2" -13 UNC x 1 1/4" LG.		4

FIGURE 31 PLATFORM CONTROL CONSOLE ASSEMBLY

REF	DESCRIPTION	PART NUMBER	QTY
-31	Platform Control Console Assembly	40670	1
1	Switch	40878	2
2	Switch	40877	1
3	Switch	40874	3
4	Switch	40876	1
5	Handle	40866	4
6	Switch	40873	2
7	Switch	40875	1
8	Panel	40868	1
9	Exterior Panel Housing	40870	1
10	Decal Label	40869	1
11	Switch	40871	1
12	Indicator Lamp	40879	1
13	Switch Guard	40880	10
14	110 Volt Receptical	40881	1

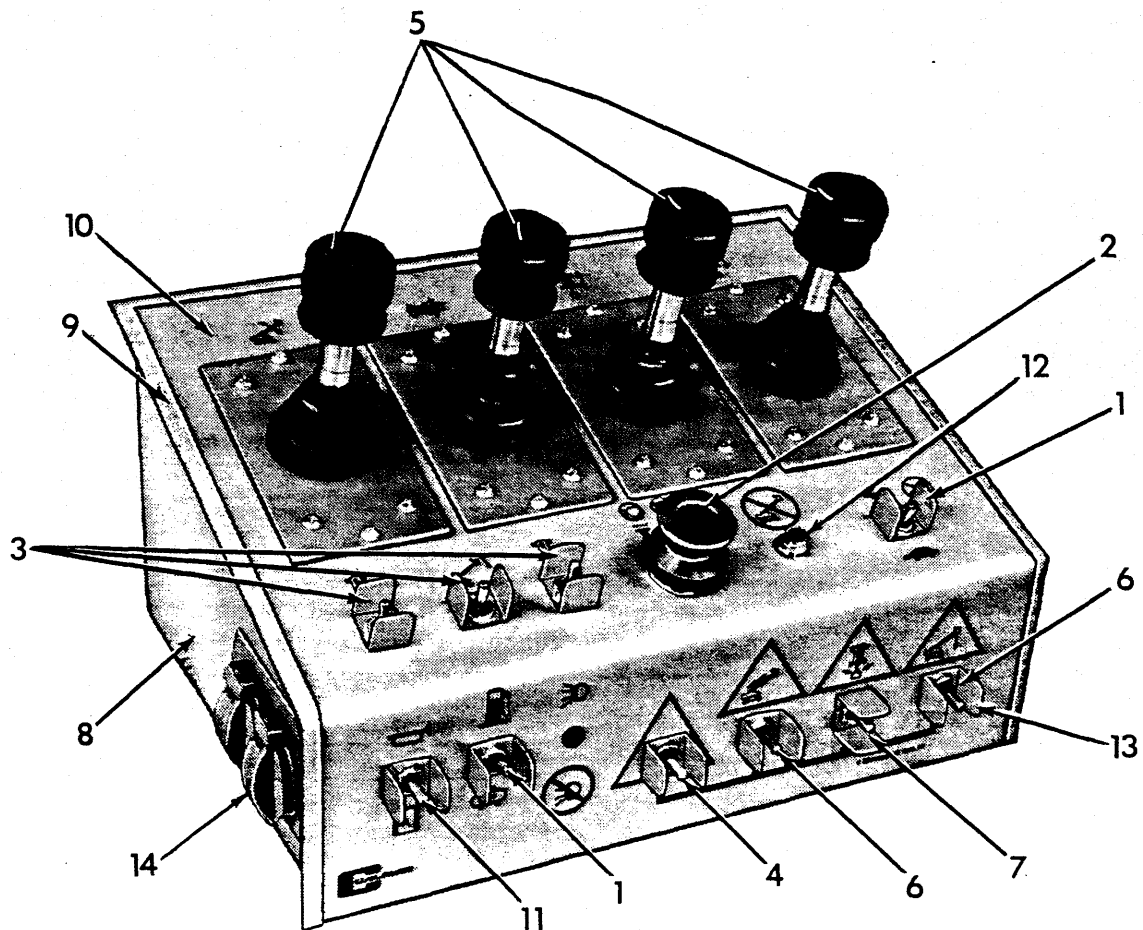


FIGURE 32 PLATFORM WELDMENT (ALL MODELS)

REF	DESCRIPTION	PART NUMBER	QTY
	60" x 36" x 43 1/2" High Platform Weldment	32723	1

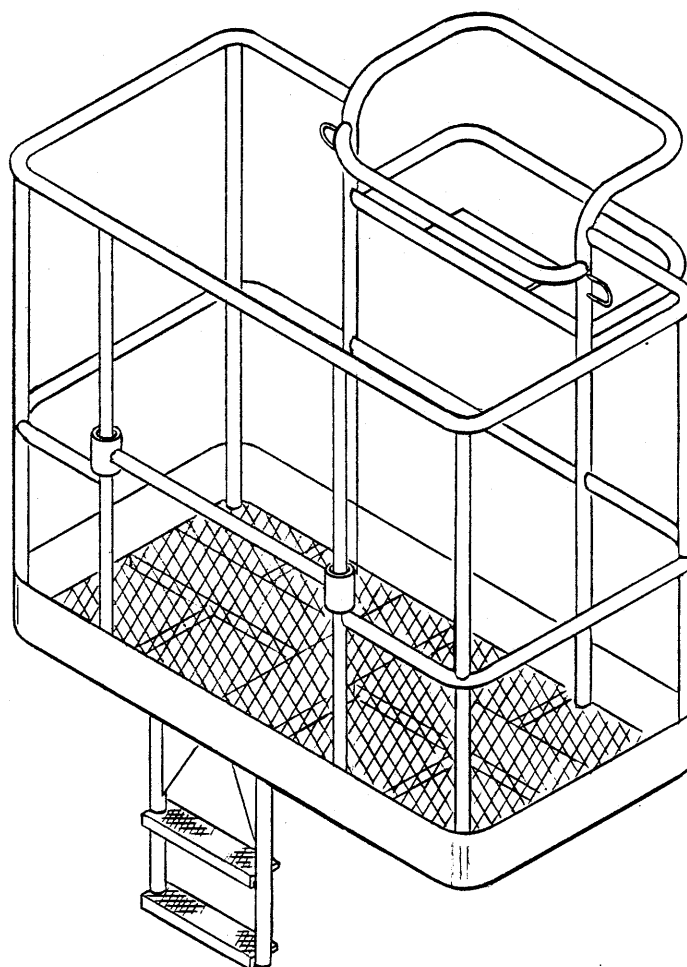


FIGURE 35X PLATFORM ROTATION ASSEMBLY (Actuator with hollow pinion)

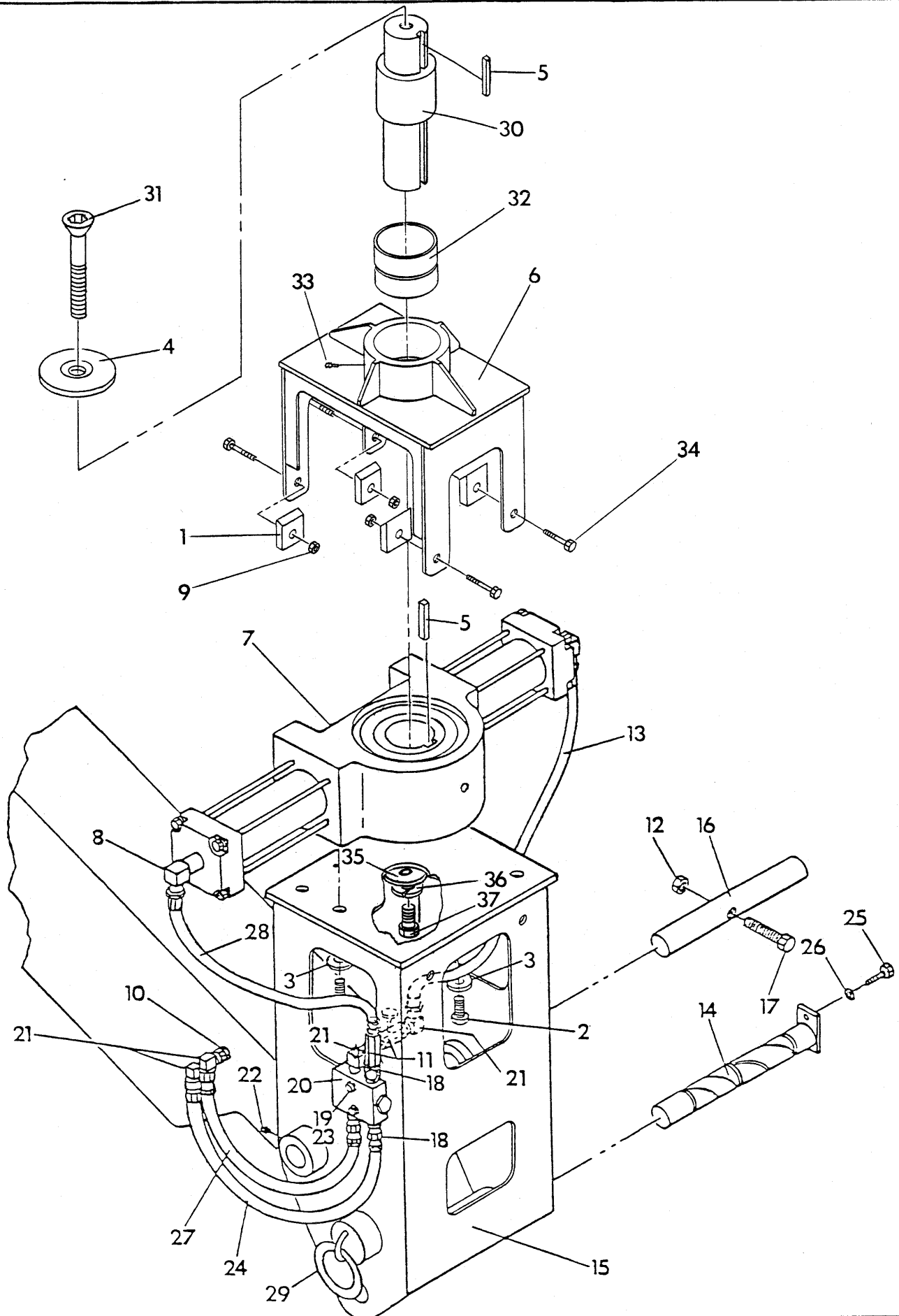


FIGURE 35X PLATFORM ROTATION ASSEMBLY (Actuator with hollow pinion)

REF	DESCRIPTION	PART NUMBER	QTY
1	Spacer	68418-9	4
2	Capscrew, 1/2" - 13 UNC x 1 - 1/4" Lg.	Gr. 8	4
3	Flatwasher, 1/2"		4
4	Stepped Washer	32775	1
5	Key, 1/2" SQ.		2
6	Mount Platform	68418	1
7	180° Rotary Actuator	68425	1
8	90° Elbow	2024TA 6-16	2
9	Locknut, 1/2" - 13 UNC (Bowma-Grip)	Gr. 5	4
10	Bulkhead Adapter	2041TA 6-6	2
11	Needle Valve	21479	2
12	Locknut, 3/8" - 16 UNC		1
13	Hose Assembly	32749	1
14	Pin, Main Leveling Skirt	21126	1
15	Skirt	(*)	1
16	Pin, Boom to Skirt	32634	1
17	Capscrew, 3/8" - 16 UNC x 3-1/2" Lg.		1
18	Adapter, STR	2021-6-6	2
19	Capscrew, Hex Hd. 1/4" - 20 NC x 1-3/4" Lg.		2
20	Double Check Valve	21480	1
21	90° Elbow	2024-6-6	4
22	Lube Fitting (Zerk) 1/8" NPT		2
23	Lockwasher, 1/4"		2
24	Hose Assembly	32749-1	1
25	Capscrew, Hex Hd. 1/4" - 20 UNC x 1/2" Lg.		1
26	Lockwasher, 1/4"		1
27	Hose Assembly	32749-2	1
28	Hose Assembly	32749-4	1
29	Tie Down Ring	32536	2
30	Shaft, Actuator	58036	1
31	Flathead Screw 1/2" - 13 UNC x 4" Lg.	Gr. 8	1
32	Bushing	68418-8	1
33	Grease Fitting (Zerk) 1/4" - 28 UNF		1
34	Capscrew, Hex Hd. 1/2" - 13 UNC x 1-1/2" Lg.	Gr. 5	4
35	Spacer	40976	1
36	Lockwasher, 7/8"		1
37	Capscrew, Hex Hd. 7/8" - 9 UNC x 2-1/2" Lg.	Gr. 8	1
	(*) For Industrial Condor Models 36N, 46N: Skirt	32771	
	For Construction Condor Models 48, 50, 56, 58, 68, 76: Skirt	32711	

FIGURE 35Z PLATFORM ROTATION ASSEMBLY (Actuator with integral pinion-shaft)

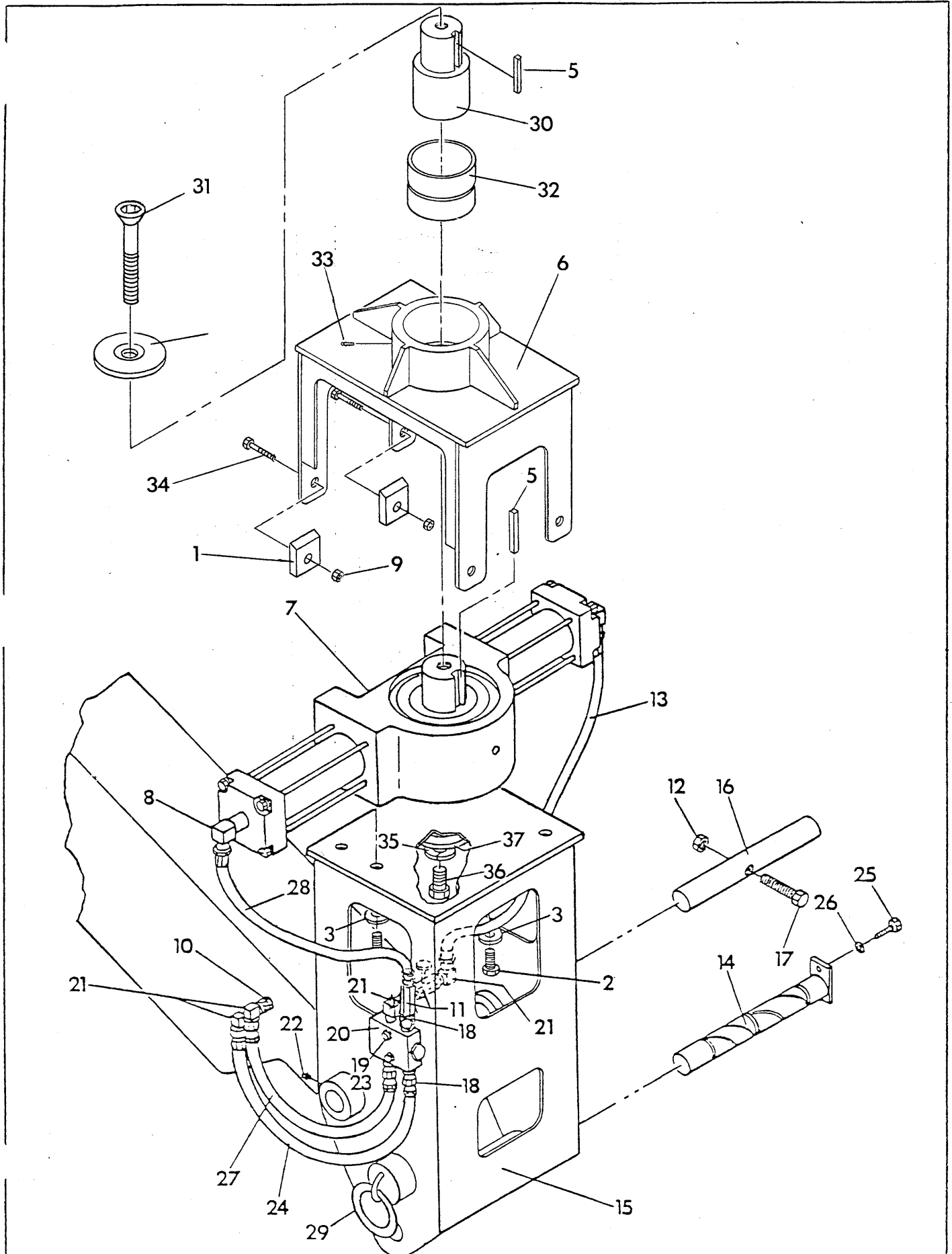


FIGURE 35Z PLATFORM ROTATION ASSEMBLY (Actuator with integral pinion-shaft)

REF	DESCRIPTION	PART NUMBER	QTY
1	Spacer	68418-9	4
2	Capscrew, 1/2" - 13 UNC x 1 - 1/4" Lg.	Gr. 8	4
3	Flatwasher, 1/2"		4
4	Stepped Washer	32775	1
5	Key, 1/2" SQ.		2
6	Mount Platform	68418	1
7	180° Rotary Actuator	32735	1
8	90° Elbow	2024TA 6-16	2
9	Locknut, 1/2" - 13 UNC (Bowma-Grip)	Gr. 5	4
10	Bulkhead Adapter	2041TA 6-6	2
11	Needle Valve	21479	2
12	Locknut, 3/8" - 16 UNC		1
13	Hose Assembly	32749	1
14	Pin, Main Leveling Skirt	21126	1
15	Skirt	(*)	1
16	Pin, Boom to Skirt	32634	1
17	Capscrew, 3/8" - 16 UNC x 3-1/2" Lg.		1
18	Adapter, STR	2021-6-6	2
19	Capscrew, Hex Hd. 1/4" - 20 NC x 1-3/4" Lg.		2
20	Double Check Valve	21480	1
21	90° Elbow	2024-6-6	4
22	Lube Fitting (Zerk) 1/8" NPT		2
23	Lockwasher, 1/4"		2
24	Hose Assembly	32749-1	1
25	Capscrew, Hex Hd. 1/4" - 20 UNC x 1/2" Lg.		1
26	Lockwasher, 1/4"		1
27	Hose Assembly	32749-2	1
28	Hose Assembly	32749-4	1
29	Tie Down Ring	32536	2
30	Shaft, Actuator	68419	1
31	Flathead Screw 1/2" - 13 UNC x 4" Lg.	Gr. 8	1
32	Bushing	68418-8	1
33	Grease Fitting (Zerk) 1/4" - 28 UNF		1
34	Capscrew, Hex Hd. 1/2" - 13 UNC x 1-1/2" Lg.	Gr. 5	4
35	Spacer	40976	1
36	Lockwasher, 7/8"		1
37	Capscrew, Hex Hd. 7/8" - 9 UNC x 2-1/2" Lg.	Gr. 8	1
	(*) For Industrial Condor Models 36N, 46N: Skirt	32771	
	For Construction Condor Models 48, 50, 56, 58, 68, 76: Skirt	32711	

FIGURE 35A 180° ROTARY ACTUATOR (with hollow pinion and SAE ports)

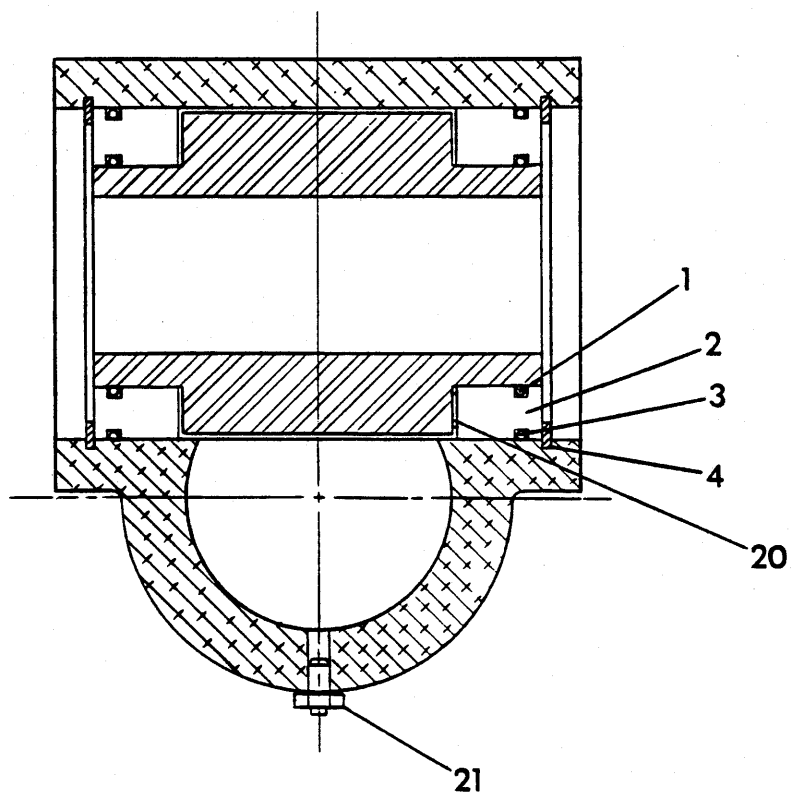
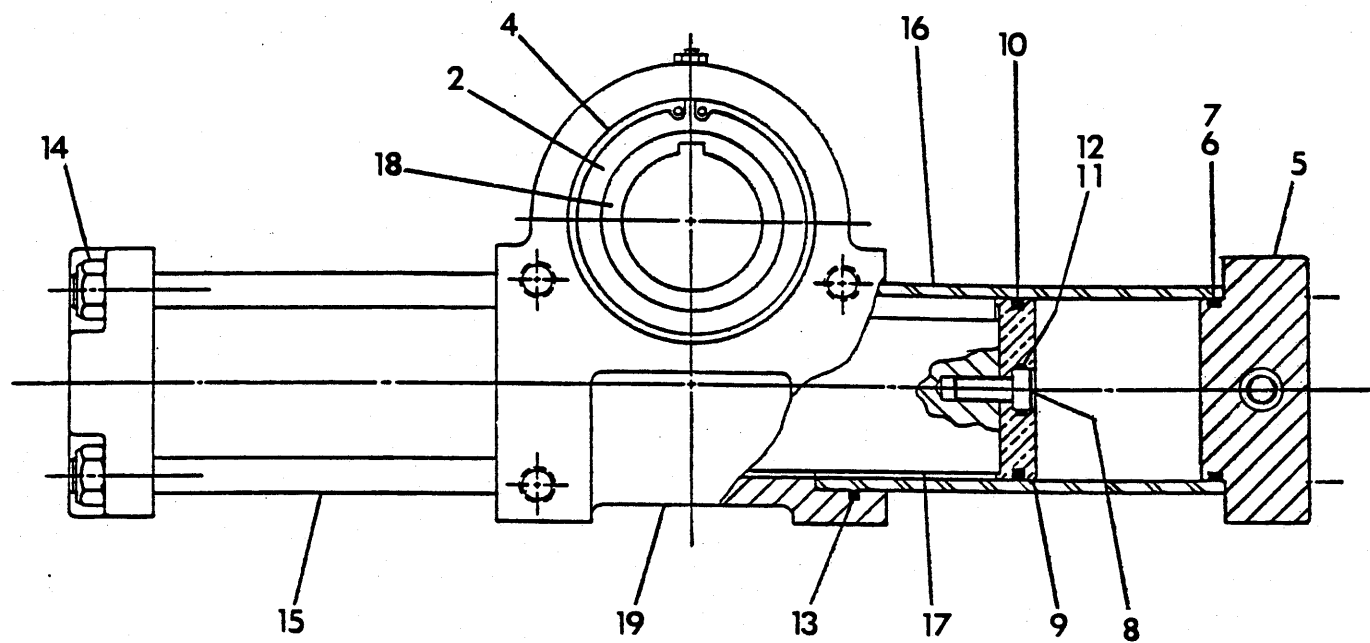


FIGURE 35A 180° ROTARY ACTUATOR (with hollow pinion and SAE ports)

REF	DESCRIPTION	PART NUMBER	QTY
	180° Rotary Actuator (with hollow pinion)	35460	1
1	O-Ring (Pinion)	*	2
2	Bushing (Pinion)	93076	2
3	O-Ring (Pinion Bushing)	*	2
4	Snap Ring	93077	2
5	End Cap	93078	2
6	Back-Up Ring (End Cap)	*	2
7	O-Ring (End Cap)	*	2
8	Rack Bolt	93080	2
9	Piston	93071	2
10	Piston Seal	*	2
11	O-Ring (Rack Bolt)	*	2
12	Back-Up Ring (Rack Bolt)	*	2
13	O-Ring (Cylinder Tube)	*	2
14	Nut (Tie-rod)	93070	8
15	Tie-Rod	93072	8
16	Cylinder Tube	93079	2
17	Rack	93081	1
18	Pinion	93082	1
19	Housing	93074	1
20	Thrust Ring	93075	2
21	Relief Valve	93073	1
	* Seal Kit, Calavar Part No. 93083, includes items 1, 3, 6, 7, 10, 11, 12 and 13 above.		

FIGURE 35A 180° ROTARY ACTUATOR (with hollow pinion and SAE ports)

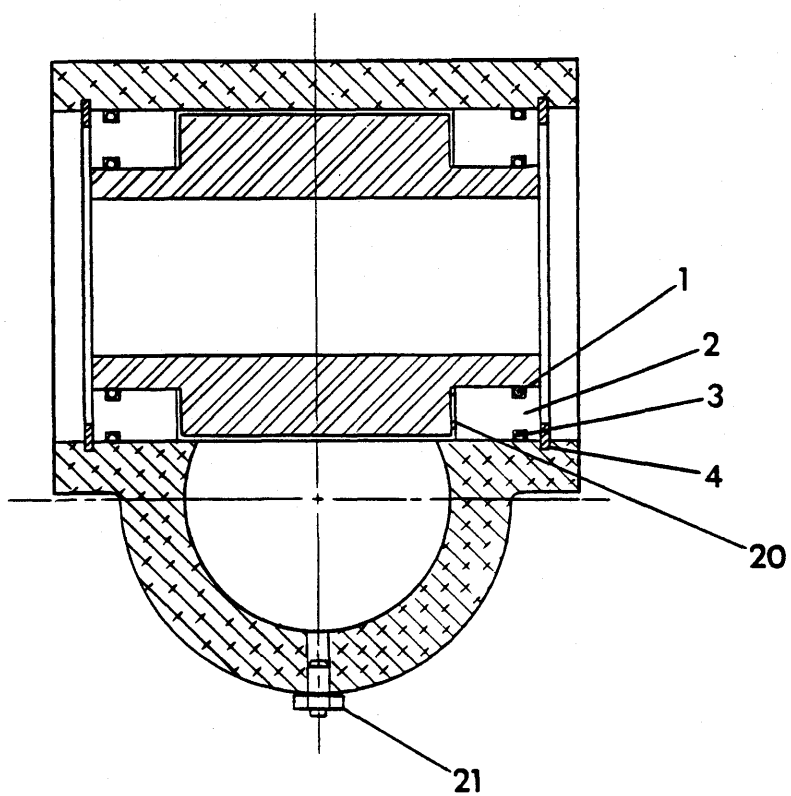
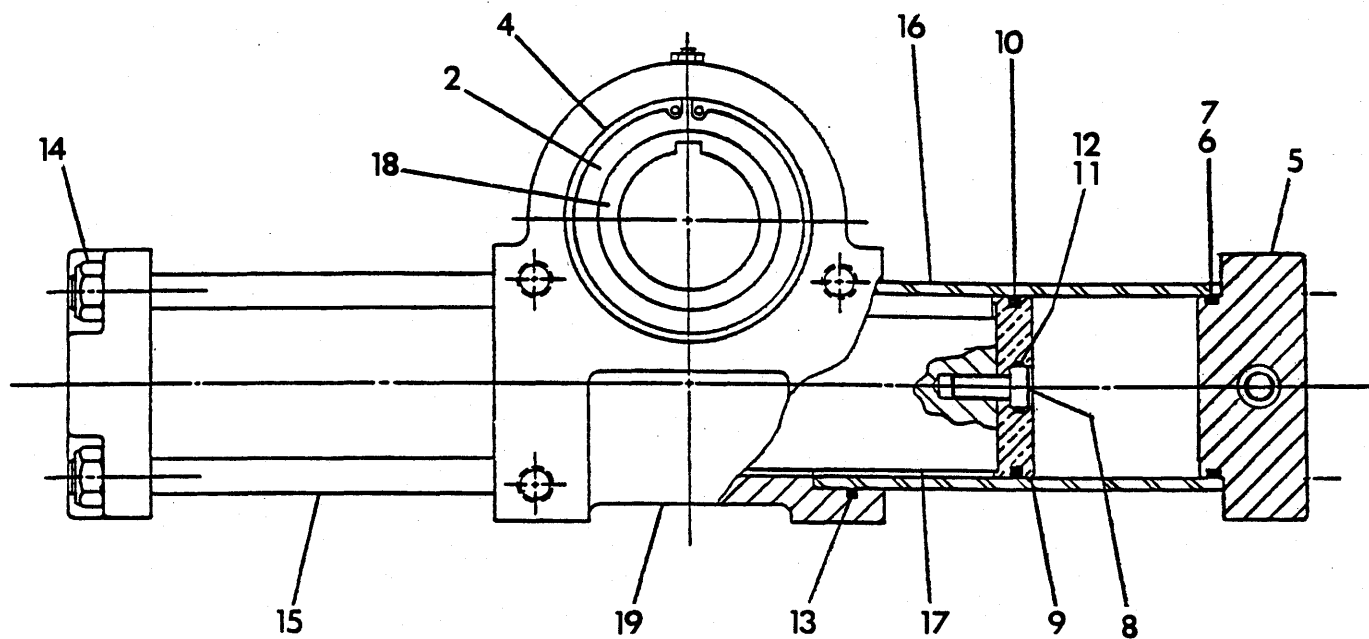


FIGURE 35B 180° ROTARY ACTUATOR (with integral pinion-shaft) #32735

REF	DESCRIPTION	PART NUMBER	QTY
1	O-Ring (Pinion)	*	2
2	Bearing	93061	2
3	O-Ring (Pinion Bushing)	*	2
4	Snap Ring	93050	2
5	End Cap	93051	2
6	Back-up Ring (End Cap)	*	2
7	O-Ring (End Cap)	*	2
8	Rack - Bolt	93052	2
9	Piston	93053	2
10	Piston Seal	*	2
11	O-Ring (Rack - bolt)	*	2
12	Back-up Ring (Rack - bolt)	*	2
13	O-Ring (Cylinder Tube)	*	2
14	Nut (Tie-rod)	93054	8
15	Tie Rod	93055	8
16	Cylinder Tube	93056	2
17	Rack	93057	1
18	Pinion	32683	1
19	Housing	93058	1
20	Bearing Cap	93062	2
21	Shims		
22	Relief Valve	93059	1
* Seal Kit, Calavar Part No. 93044, includes Items 1, 3, 6, 7, 10, 11, 12, & 13			

FIGURE 36 - AIRLINE (OPTION 21057)

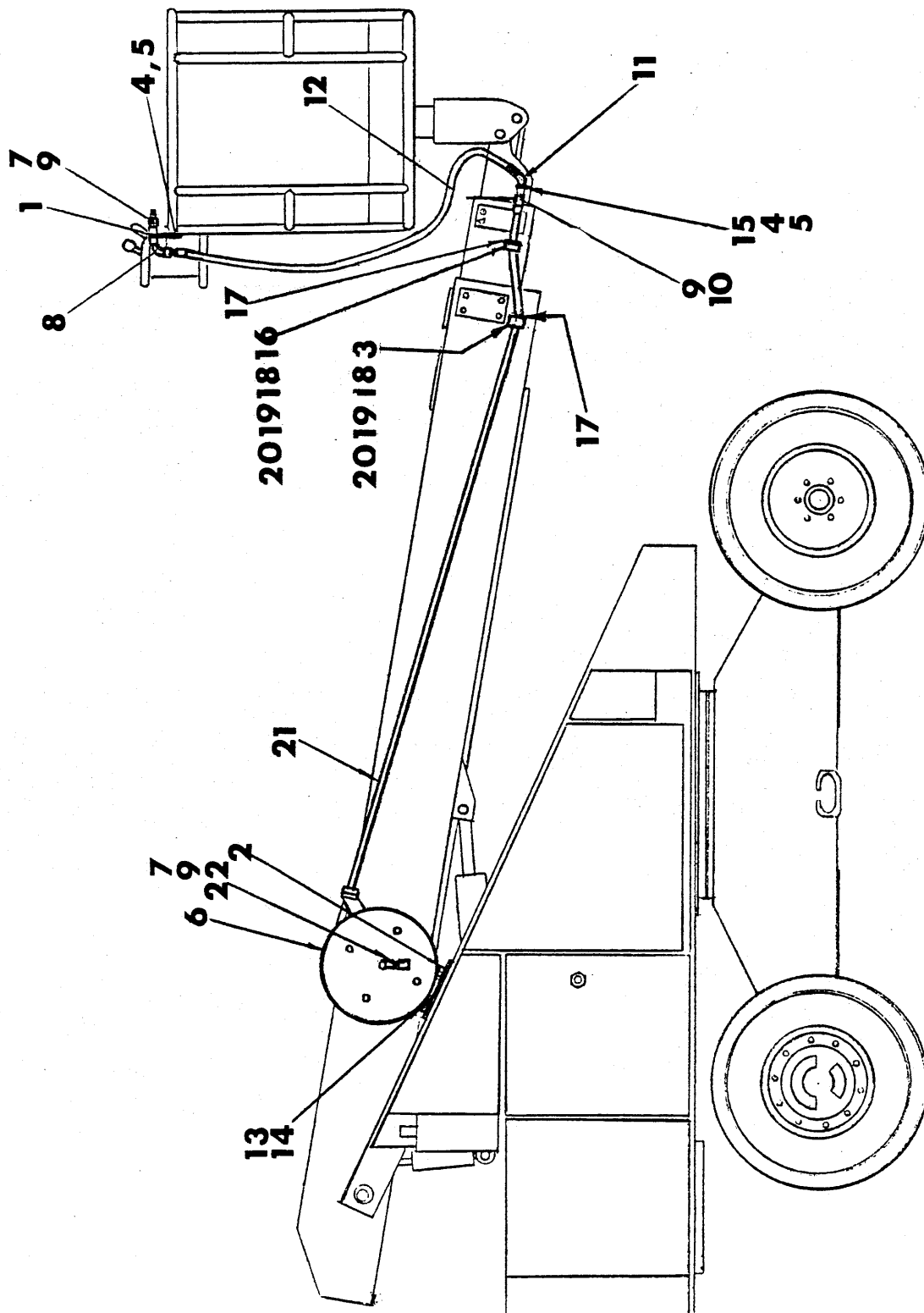
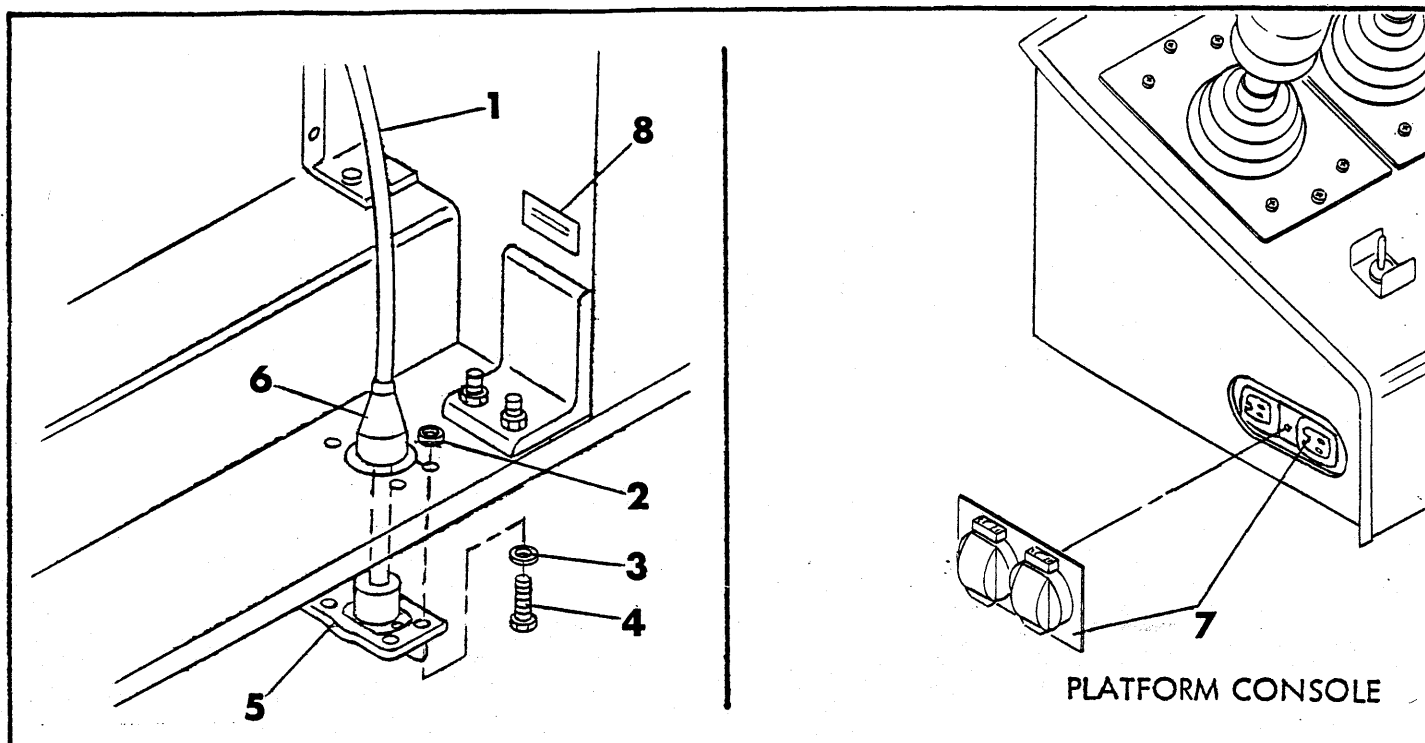


FIGURE 36 - AIRLINE (OPTION 21057)

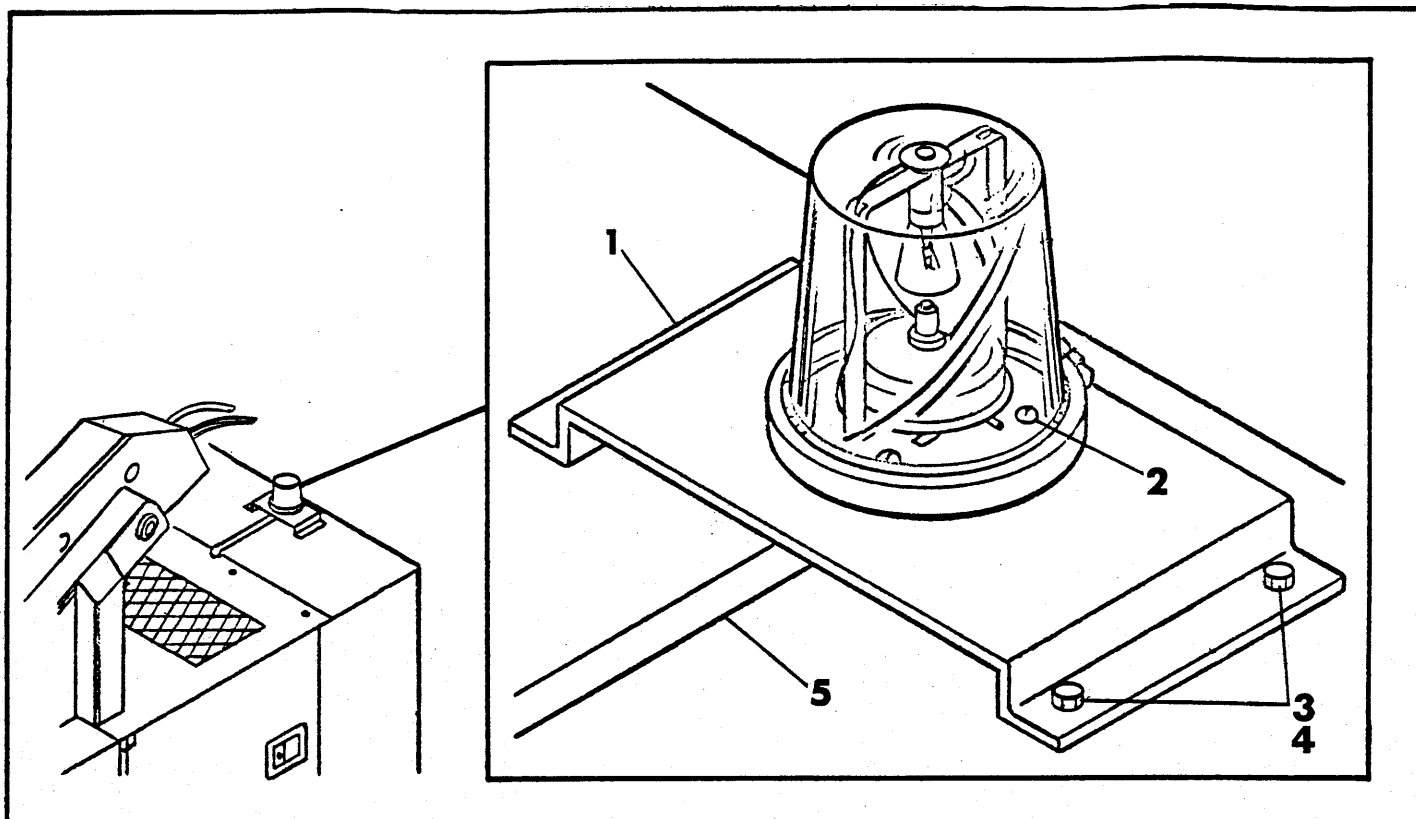
REF	DESCRIPTION	PART NUMBER	QTY
36-	Airline	21057	1
- 1	Platform Bracket	21382-1	1
- 2	Mounting Plate	21984	1
- 3	Roller Guide	77-2A	1
- 4	Hex Head Capscrew	$\frac{1}{4}$ -28 UNF X 5/8	4
- 5	Lockwasher	1/4	4
- 6	Air Hose Reel Assembly	21394	1
- 7	Plug	80	2
- 8	90° Elbow	2103-8-8	1
- 9	Socket	8300	3
-10	Plug	85	1
-11	45° Elbow	3103-8-8	1
-12	Hose Assembly	FG1060-HHH-0520	1
-13	Hex Head Capscrew	3/8-16 UNC X $\frac{1}{2}$	4
-14	Lockwasher	3/8	4
-15	Boom Bracket	21382-2	1
-16	Roller Guide	77-1A	1
-17	Hose Guide Bracket	21382-3	2
-18	Slotted Round Head Screw	No. 10-24 UNC X 5/8	8
-19	Hex Nut	No. 10-24 UNC	8
-20	Lockwasher	No. 10	8
-21	Air Hose	$\frac{1}{2}$ I.D. 200 X A/R PSI W.P.	1
-22	90° Elbow	2102-8-8	2

FIGURE 37 - 110 VOLT BOOM ELECTRICAL LINE (STANDARD)



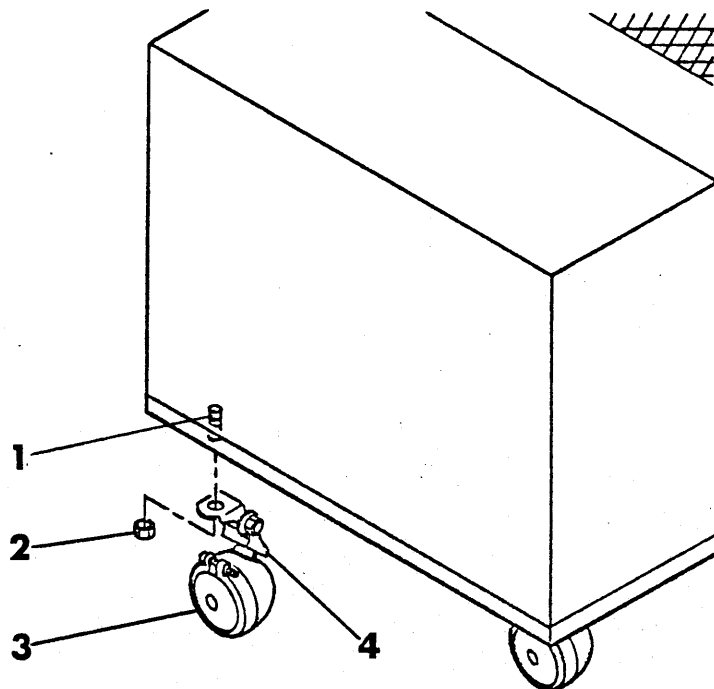
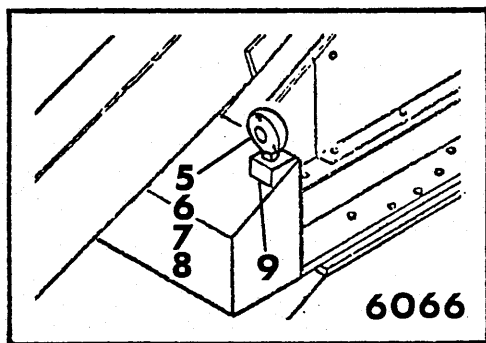
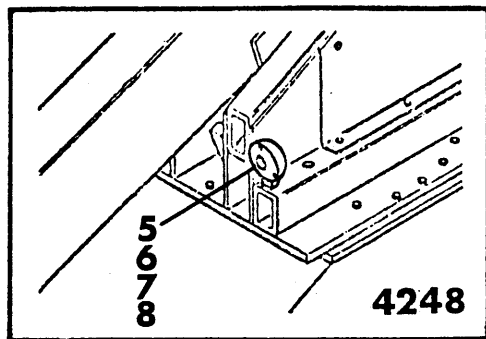
REF	DESCRIPTION	PART NUMBER	QTY
37-	110 Volt Boom Electrical Line	Part of 21748	1
- 1	Cable to Ground Control Box	(Reference)	1
- 2	Pre-Assembled Nut and Lockwasher	No. 10-32 UNF	4
- 3	Flat Washer	No. 10	4
- 4	Round Head Screw	10-32 UNF X 1- $\frac{1}{2}$	4
- 5	110 Volt Receptacle	7600	1
- 6	Rubber Boot	7531	1
- 7	Outlet with Lift Cover	5214	1
- 8	Decal "110 Volts"	15376-24	2

FIGURE 38 - ROTATING BEACON (OPTION 21059)



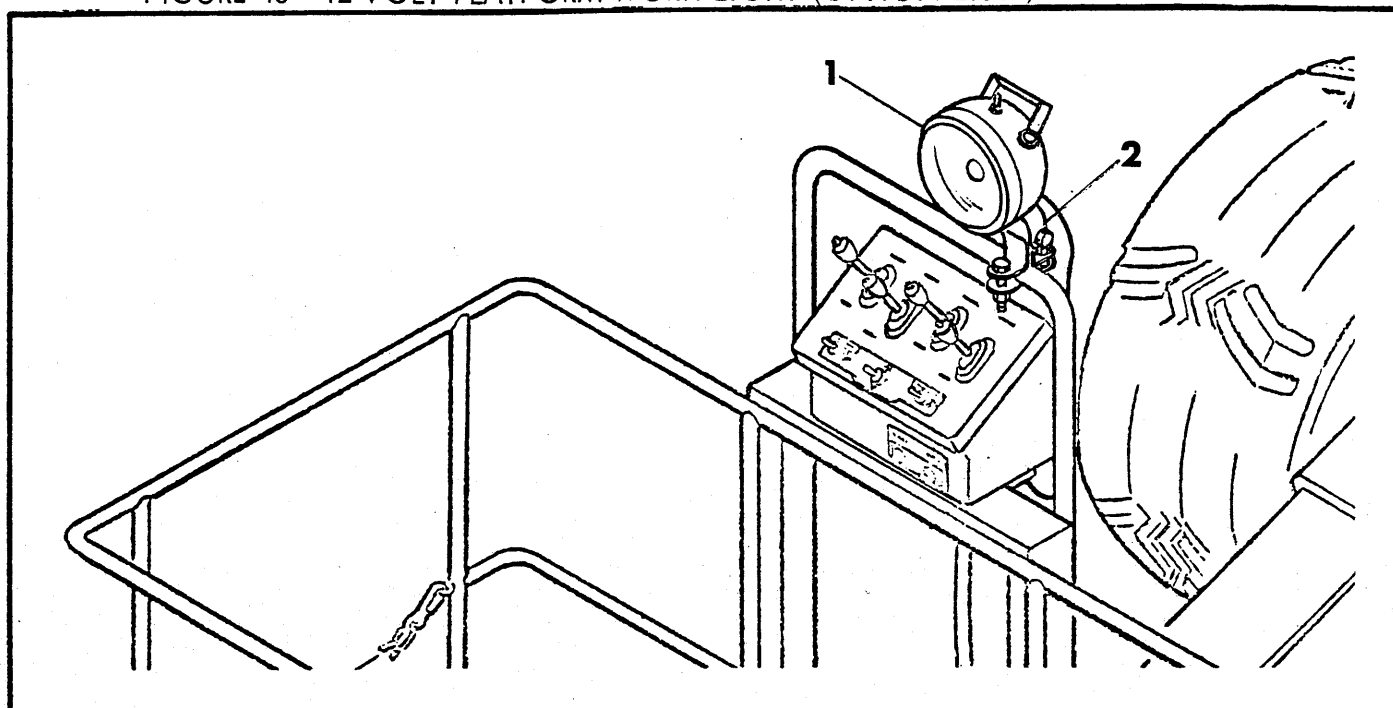
REF	DESCRIPTION	PART NUMBER	QTY
38-	Rotating Beacon	21344	1
- 1	Mounting Bracket	21642	1
- 2	Sheet Metal Screw	Part of 21344	3
- 3	Hex Head Capscrew	$\frac{1}{4}$ -20 UNC X $\frac{3}{4}$	4
- 4	Lockwasher	$\frac{1}{4}$	4
- 5	Wire Tube	(Reference)	1

FIGURE 39 - HEAD LIGHTS AND TAIL LIGHTS FOR IN-PLANT OPERATION (OPTION21060)



REF	DESCRIPTION	PART NUMBER	QTY
39-	Head Lights and Tail Lights for In-Plant Operation	21060	1
- 1	Stud ($\frac{1}{2}$ ")	(Reference)	2
- 2	Hex Nut	1/2-20UNF X 1-1/8	2
- 3	Head Light Assembly	009-45601	2
- 4	Mounting Bracket Assembly	Part of 009-45601	2
- 5	Tail Light Assembly	3701-DOT	2
- 6	Lamp	1157	2
- 7	Red Lens	SAE-ST164	2
- 8	Body	37ST	2
- 9	Mounting Bracket	21933	2
-10	Switch*	8500	1
-11	Placard "LIGHTS"*	21978	1
-12	Relay*	1116969	1
	* Located in Platform Control Console		

FIGURE 40 - 12 VOLT PLATFORM WORK LIGHT (OPTION 21062)



REF	DESCRIPTION	PART NUMBER	QTY
40-	12 Volt Platform Work Light	21062	1
-1	Work Light Assembly	009-50202	1
-2	Mounting Bracket Assembly	Part of 009-50202	1

FIGURE 42 PLATFORM OPTIONS

REF	DESCRIPTION	PART NUMBER	QTY
	4 Ft. x 36" x 42" Platform Weldment	32753	
	6 Ft. x 36" x 42" Platform Weldment	32769	
	8 Ft. x 36" x 42" Platform Weldment	32770	

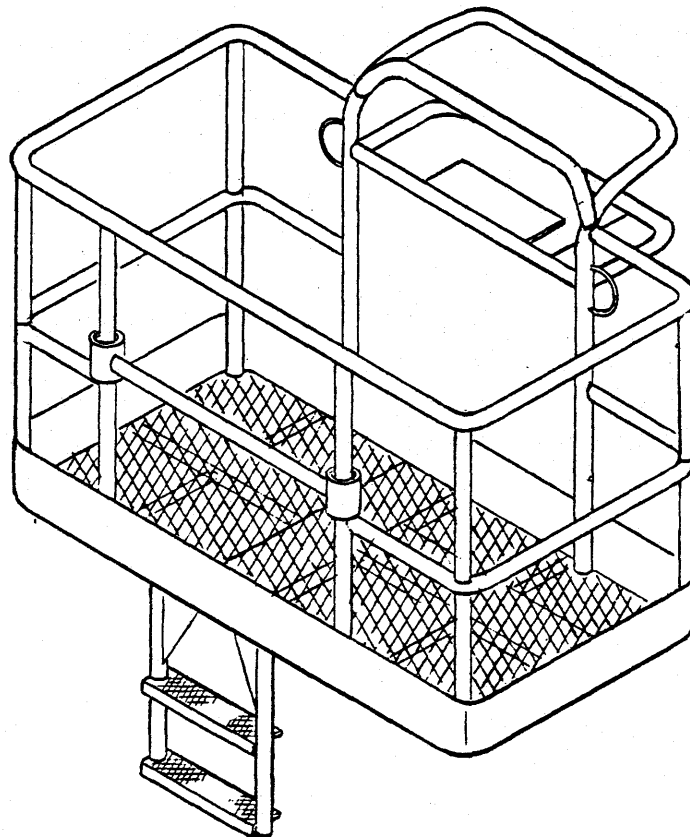


FIGURE 43 DIESEL ENGINE ASSEMBLY (OPTION 21066)

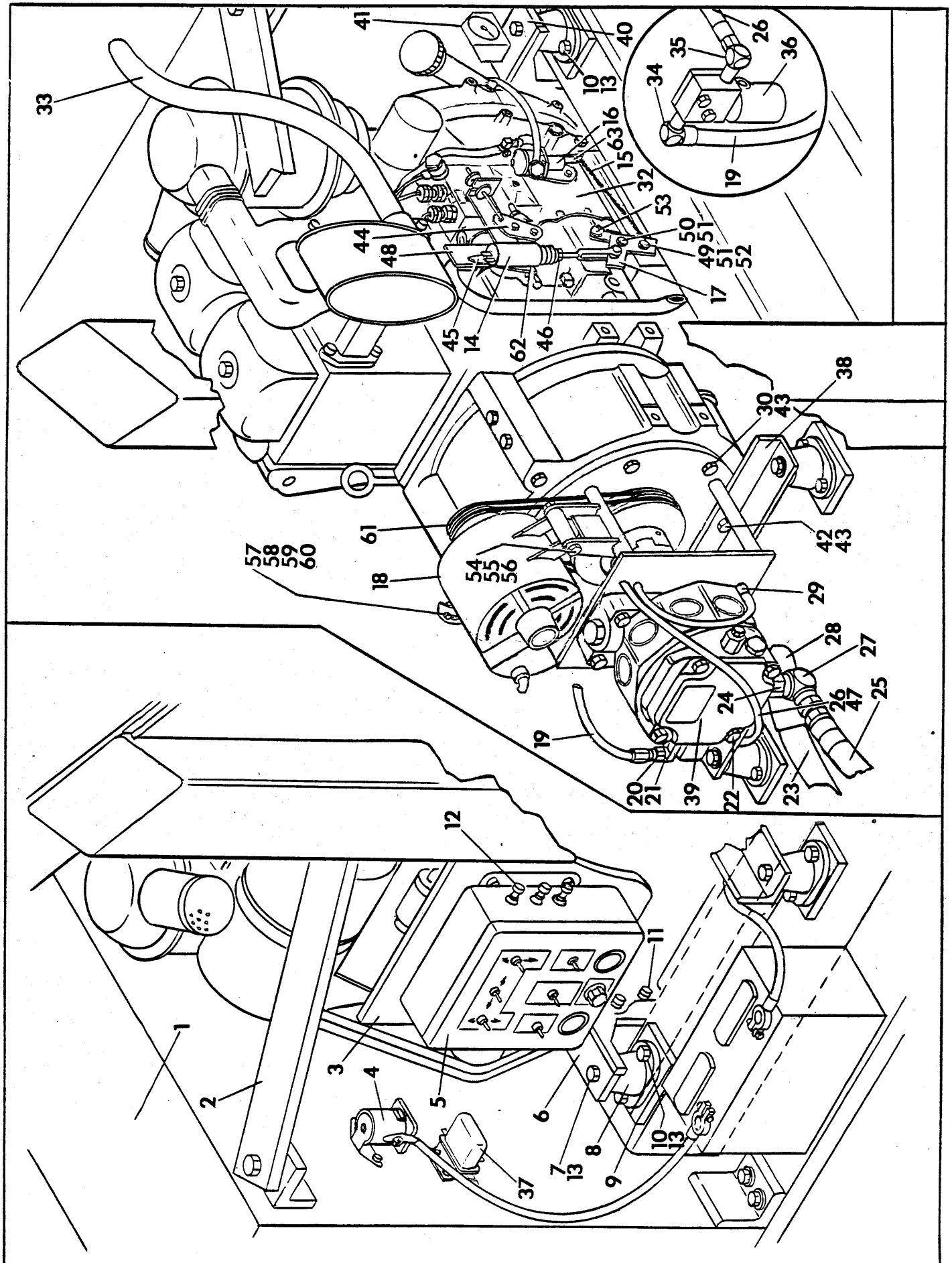


FIGURE 43 DIESEL ENGINE ASSEMBLY (OPTION 21066)

REF	DESCRIPTION	PART NUMBER	QTY
1	Counterweight Assembly	40085 (3238)	1
		40086 (4056)	1
		40087 (4248)	1
		40088 (6066)	1
2	Counterweight Bracket	(Reference)	1
3	Ground Control Box - Mounting Bracket	(Reference)	1
4	Starter Solenoid (Motorcraft)	21342	1
5	Ground Control Box	(Reference)	1
6	Engine Mount Bracket (Left Front)	21856	1
7	Hex Head Capscrew	1/2" - 13 UNC x 1"	4
8	Engine Mount	520-RMD	4
9	Engine Mount Plate	21857	2
10	Capscrew, Hex Head	1/2" - 13 UNC x 3/4"	8
11	Capscrew, Hex Head	(Furnished with Engine)	8
12	Circuit Breaker (20 AMP)	109-220-101	3
13	Lockwasher	1/2"	12
14	Solenoid	40808	1
15	Spring	21659	1
16	Bracket, Spring Attaching	40764	1
17	Kill Link	21929	1
18	Alternator	Mark I, 110 Volt	1
19	Hose Assembly	FG 1012-EEE-0480	1
20	Reducer	221501TRTX 6-4	1
21	O-Ring Elbow	2062 6-4	1
22	Capscrew, Hex Head	1/2"x 2 - 1/2"	4
23	Hose Assembly	FG 1556 - kkk - 9270	1
24	O-Ring Adapter	202702 10-12	1
25	Hose Assembly	FG 1011-KKK-0360	1
26	Hose Assembly	FG 1005-EEER-0300	1
27	90° Swivel Elbow	2071 12-12	1
28	90° O-Ring Elbow	2026 20-20	1
29	O-Ring Elbow	3/8" 3-4	2
30	Hex Bolt	M10 x 30 LG	6
31	Hose Assembly	3 CIT - 3FJX - 4FJX-36	1
32	Diesel Engine	21340	1
33	Exhaust Pipe	40983	1
34	90° O-Ring Elbow	2024 4-4	1
35	90 O-Ring Elbow	202413 4-4	1
36	Pump Solenoid Valve	21465	1
37	Stop Relay	1116969	1
38	Engine Mount Bracket (Rear)	40747	1
39	Pump	21478	1
40	Engine Mount Bracket (Right Front)	21853	1
41	Oil Pressure Gauge Assembly, Engine	67157-016	1
42	Capscrew, Hex Head	M10 x 40 LG.	2
43	Lockwasher	7/16"	8
44	Throttle Bracket	(Furnished with Engine)	1
45	Bracket, Solenoid Mounting	40806	6
46	Jam Nut, 1/4" - 28 UNF		6
47	O-Ring Elbow	3/8" 3-4	1

FIGURE 43 DIESEL ENGINE ASSEMBLY (OPTION 21066)

REF	DESCRIPTION	PART NUMBER	QTY
	40902		
48	Base, Shut-Off Solenoid Bracket	40902	1
49	Capscrew, Hex Head 5/16" - 18 UNC x 3/4" LG.		1
50	Capscrew, Hex Head 5/16" - 18 UNC x 5/8" LG.		1
51	Lockwasher, 5/16"		2
52	Nut, Hex 5/16" - 18 UNC		1
53	Lever, Fuel Shut-Off	Reference	1
54	Lockwasher, 3/8"		4
55	Mounting Bolt		1
56	Nut, Hex 3/8" - 18 UNC		1
57	Capscrew, Hex Head 5/16" - 18 UNC x 1" LG.		1
58	Nut, Hex 5/16" - 18		1
59	Washer, 5/16"		1
60	Lockwasher, 5/16"		1
61	Double Pulley	AG43	1
62	Bracket, Fuel Shut-Off	40761	1
63	Bracket, Spring Attaching	40764	1

FIGURE 44 WISCONSIN ENGINE WITH LP GAS (OPTION 21069)

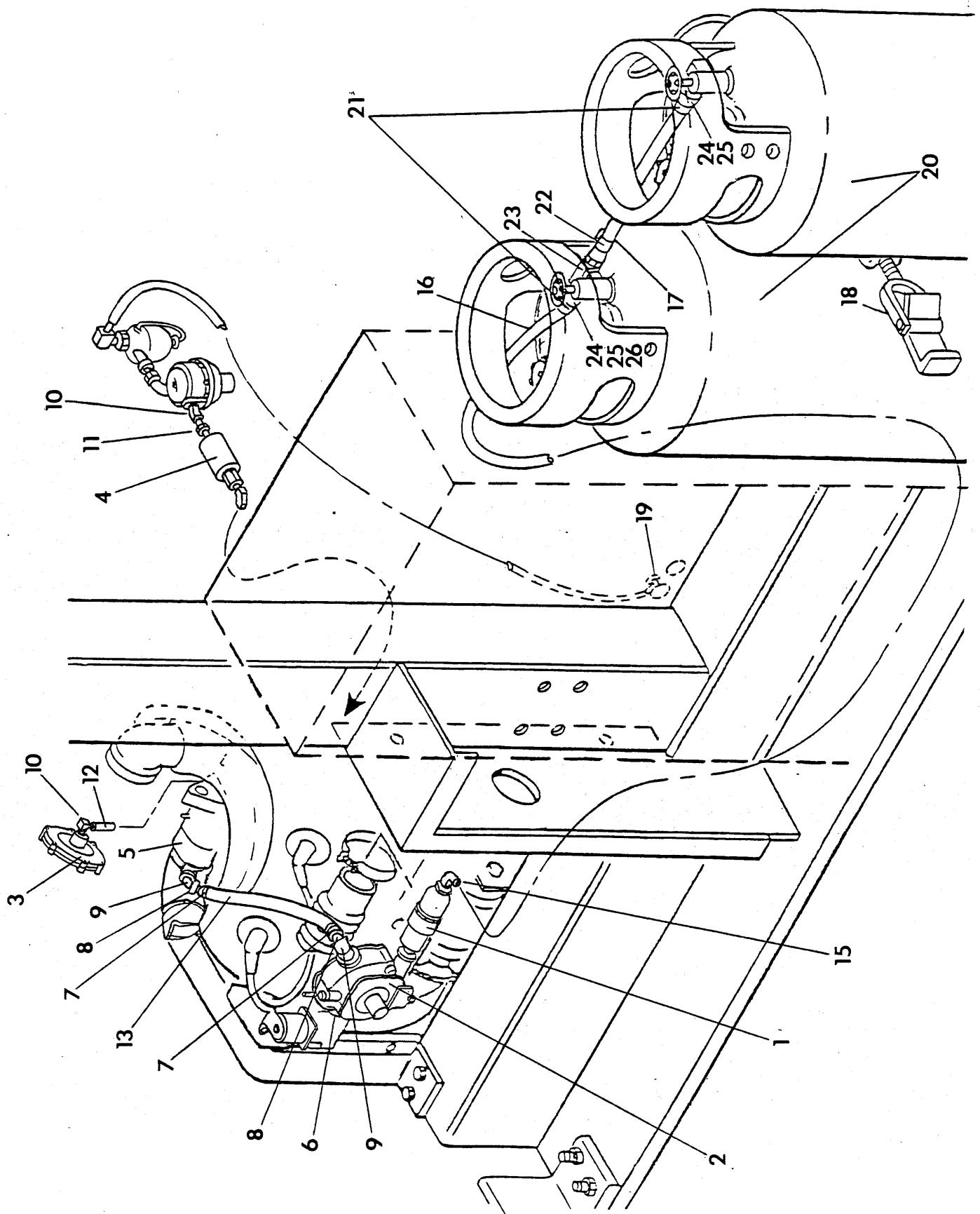
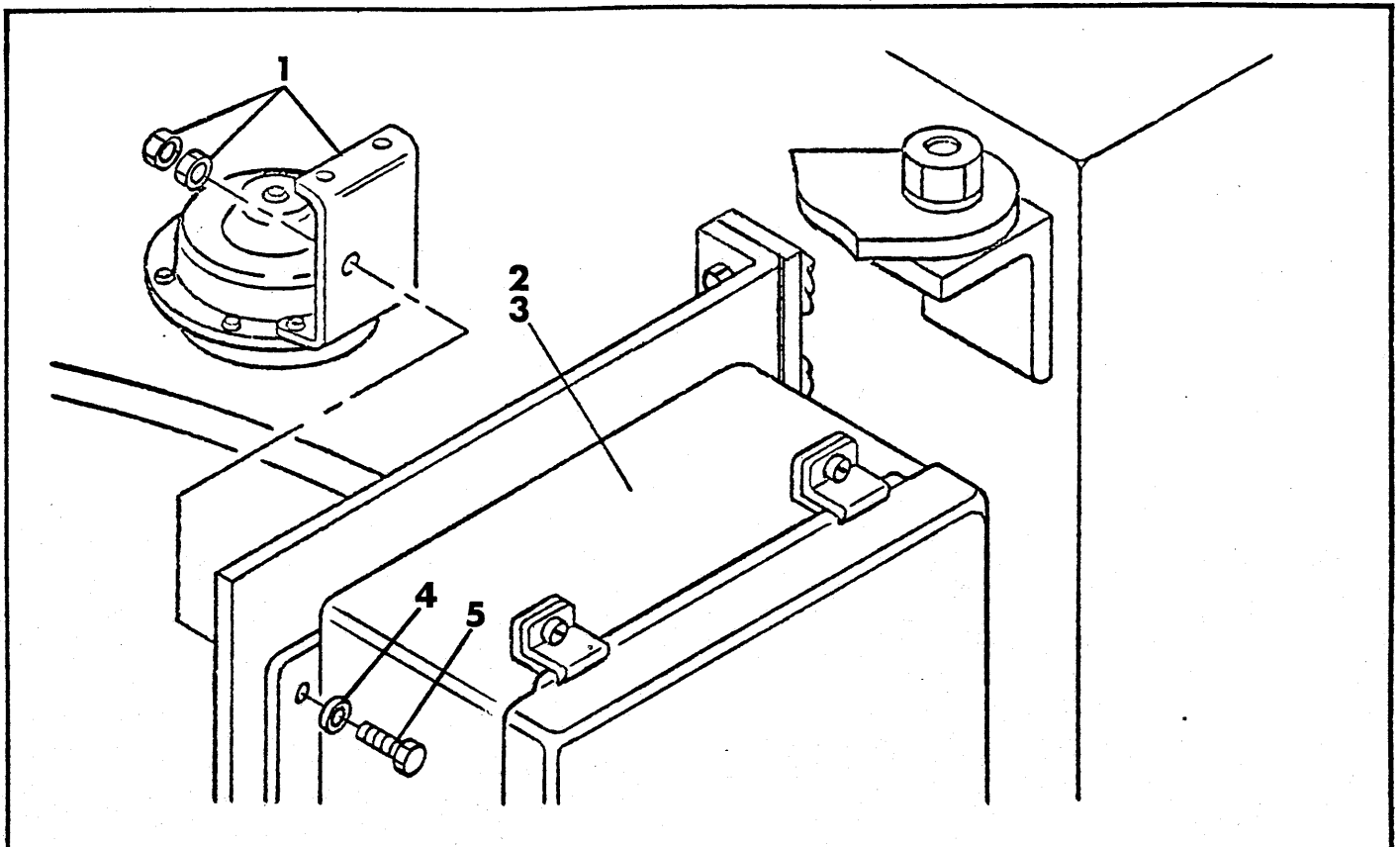


FIGURE 44 WISCONSIN ENGINE WITH LP GAS (OPTION 21069)

REF	DESCRIPTION	PART NUMBER	QTY
1	Filterlock (FL-418)	68094	1
2	Regulator Dry-Gas (50-E)	68095	1
3	Vacuum Safty Switch (1501-L)	68096	1
4	Valve Solenoid (GT-622)	68097	1
5	Adapter-Carburetor (1770-S-28)	68099	1
6	Screw-Hex Hd. 1/4-20 UNC x 5/8 LG.		4
7	Clamp-Hose 3/4" O.D.		2
8	Connector 5/8 Hose x 3/8 Pipe		2
9	Elbow 90° Street 3/8 Pipe		2
10	Elbow 45° Street 1/8 Pipe		1
11	Nipple Short Hex 1/8 Pipe		1
12	Nipple 1/8 Pipe x 2" LG.		1
13	5/8 Hose Dry Gas x 18" LG.		1
14	1/4 Lock Washer		4
15	Elbow 90° 3/8 Pipe x 3/8 JIC		1
16	Hose Assembly	FC 321-06-5/16" x 105"	1
17	Hose	FC 321-06-5/15" x 105"	1
18	Tank Bracket	TB-3	2
19	Valve	6600 (Weatherhead)	1
20	Tank (Vapor withdrawal)	33.5 Lbs.	2
21	Hose End for Items 16 and 17	411-6S	2
22	Hose End for Items 16 and 17	412-6S	2
23	Tee 1/4" Pipe Thread	3700 x 4	1
24	Quick Disconnectors	7141 M	3
25	Quick Disconnectors	7141 F	3
26	Adapter, Straight	48 x 6	1

FIGURE 45 - DESCENT HORN (OPTION 21071)



REF	DESCRIPTION	PART NUMBER	QTY
45-	Descent Horn	21071	1
-1	Horn	GR-2	1
-2	Ground Control Box (21981)	(Reference)	1
-3	Diode	1N4719	1
-4	Flat Washer	$\frac{1}{4}$	1
-5	Hex Head Capscrew	$\frac{1}{4}$ -20UNC x 3/4	1

FIGURE 46 - PLATFORM DEADMAN SWITCH (OPTION 21292)

REF	DESCRIPTION	PART NUMBER	QTY
46-			
-1	Platform Deadman Switch	21292	1
-2	Hex Head Capscrew	9002AW-17	1
-3	Lockwasher	5/16-18 UNC x 1	3
-4	Hex Nut	5/16-18 UNC	3
-5	Connector	2535	3
-6	Cable	10-2 P123-MESA 600V 6' LG (Glen Air)	1

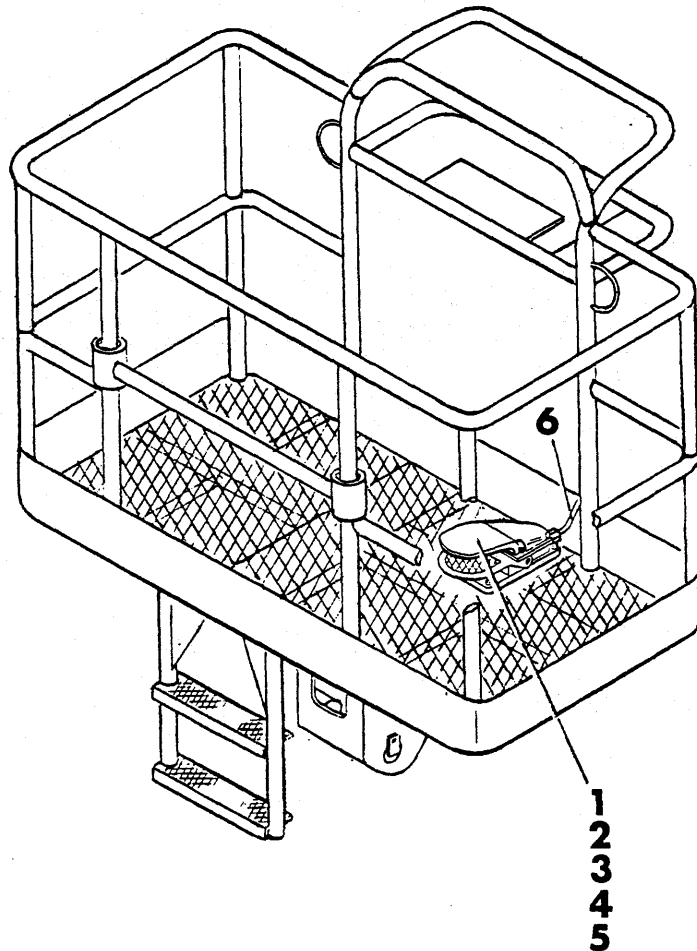
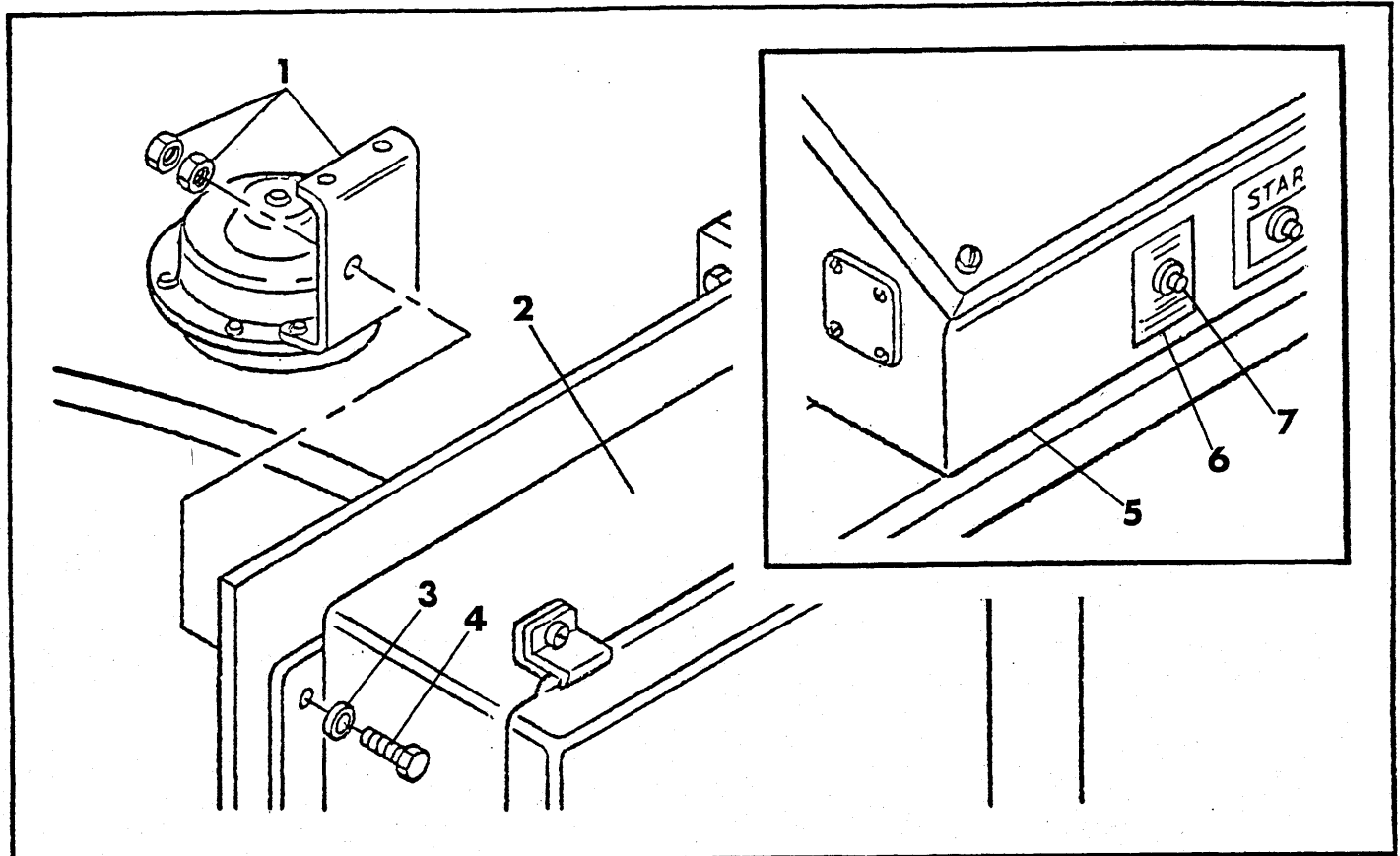


FIGURE 47-PLATFORM AUTOMOBILE TYPE HORN (OPTION 21072)



REF	DESCRIPTION	PART NUMBER	QTY
47-	Platform Automobile Type Horn	21072	1
-1	Horn	28-12VDC	1
-2	Ground Control Box	(reference)	1
-3	Flat Washer ($\frac{1}{4}$)	(reference)	1
-4	Hex Head Capscrew ($\frac{1}{4}$ -20UNC X $\frac{3}{4}$)	(reference)	1
-5	Platform Control Console	(reference)	1
-6	Decal "HORN" "PUSH TO SIGNAL"	21874	1
-7	Push Button Switch	M525089-1C	1

FIGURE 48 - 110 VOLT SHAFT DRIVEN ALTERNATOR (OPTION 21647)

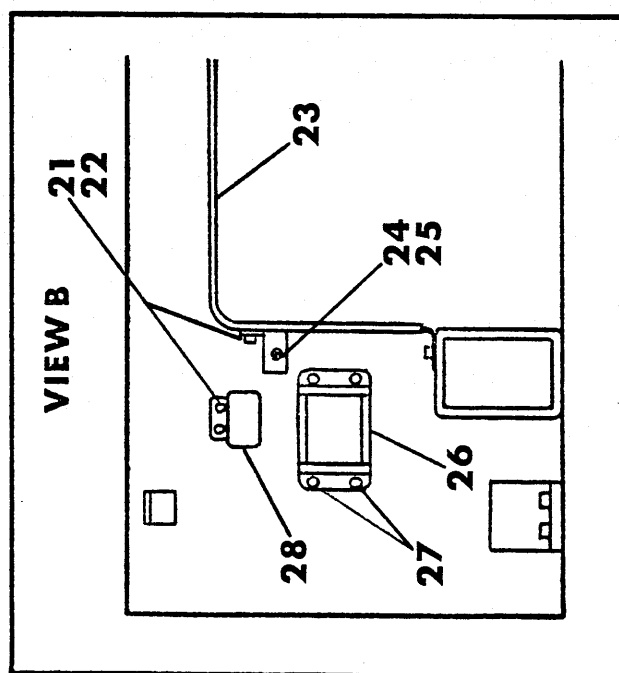
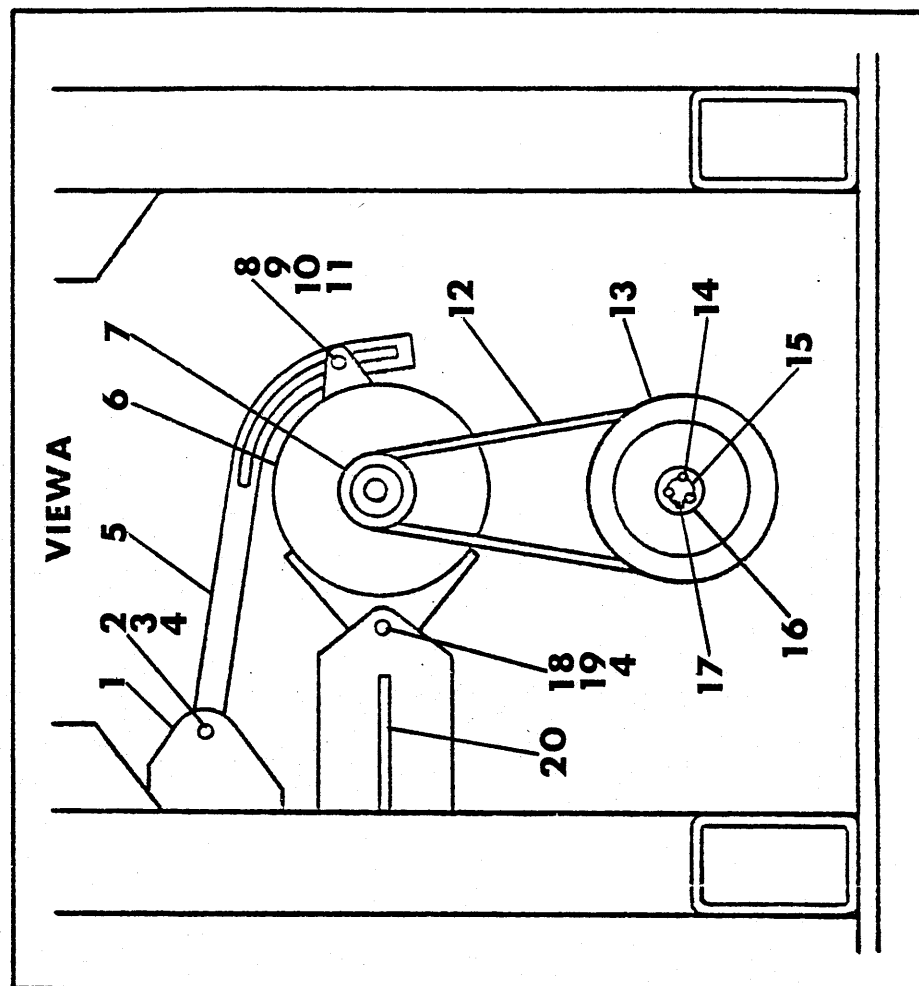
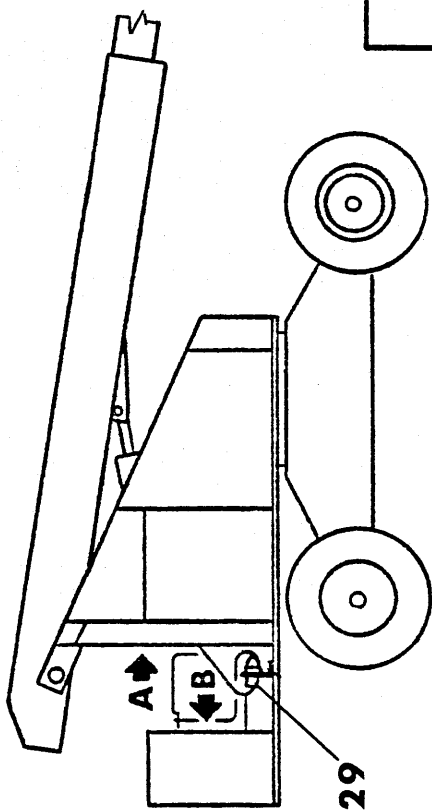


FIGURE 48 - 110 VOLT SHAFT DRIVEN ALTERNATOR (OPTION 21647)

REF	DESCRIPTION	PART NUMBER	QTY
48-	110 Volt Shaft Driven Alternator	21647	1
- 1	Arm Bracket	21900	1
- 2	Hex Head Capscrew	3/8-24 UNF X 1- $\frac{1}{4}$	2
- 3	Hex Nut	3/8-24 UNF	3
- 4	Lockwasher	3/8	4
- 5	Arm	21899	1
- 6	Alternator	Mark I, 120 Vac 2500 Watt	1
- 7	Double Pulley	AG43	1
- 8	Hex Head Capscrew	5/16-18 UNC X 1	1
- 9	Hex Nut	5/16 -18 UNC	1
-10	Washer	5/16	1
-11	Lockwasher	5/16	1
-12	Drive Belt	A38	2
-13	Pulley (Two Groove)	8.2A Pitch (Fur- nished w/Taperlock Pulley	3
-15	Engine Shaft	(Reference)	1
-16	Taperlock Bushing	2517 w/1-7/16 Bore	1
-17	Key Seat	3/8 X 3/16	1
-18	Mounting Bolt	3/8-18 UNC X4	1
-19	Hex Nut	3/8 - 18 UNC	1
-20	Mounting Bracket	21901	1
-21	Hex Head Capscrew	$\frac{1}{4}$ -20 UNC X 3/4	4
-22	Lockwasher	1/4	4
-23	Engine Flywheel Shroud	(Reference)	1
-24	Mounting Bracket	21902	1
-25	Circuit Breaker	109220-101	1
-26	Regulator	RST-2	1
-27	Hex Head Capscrew	10-32 UNF X $\frac{1}{2}$	4
-28	Relay	1116969	1
-29	Outlet and Plate	5214	1

FIGURE 49 - AUXILIARY HYDRAULIC POWER PACK INSTALLATION (OPTION 21648 & 21650)

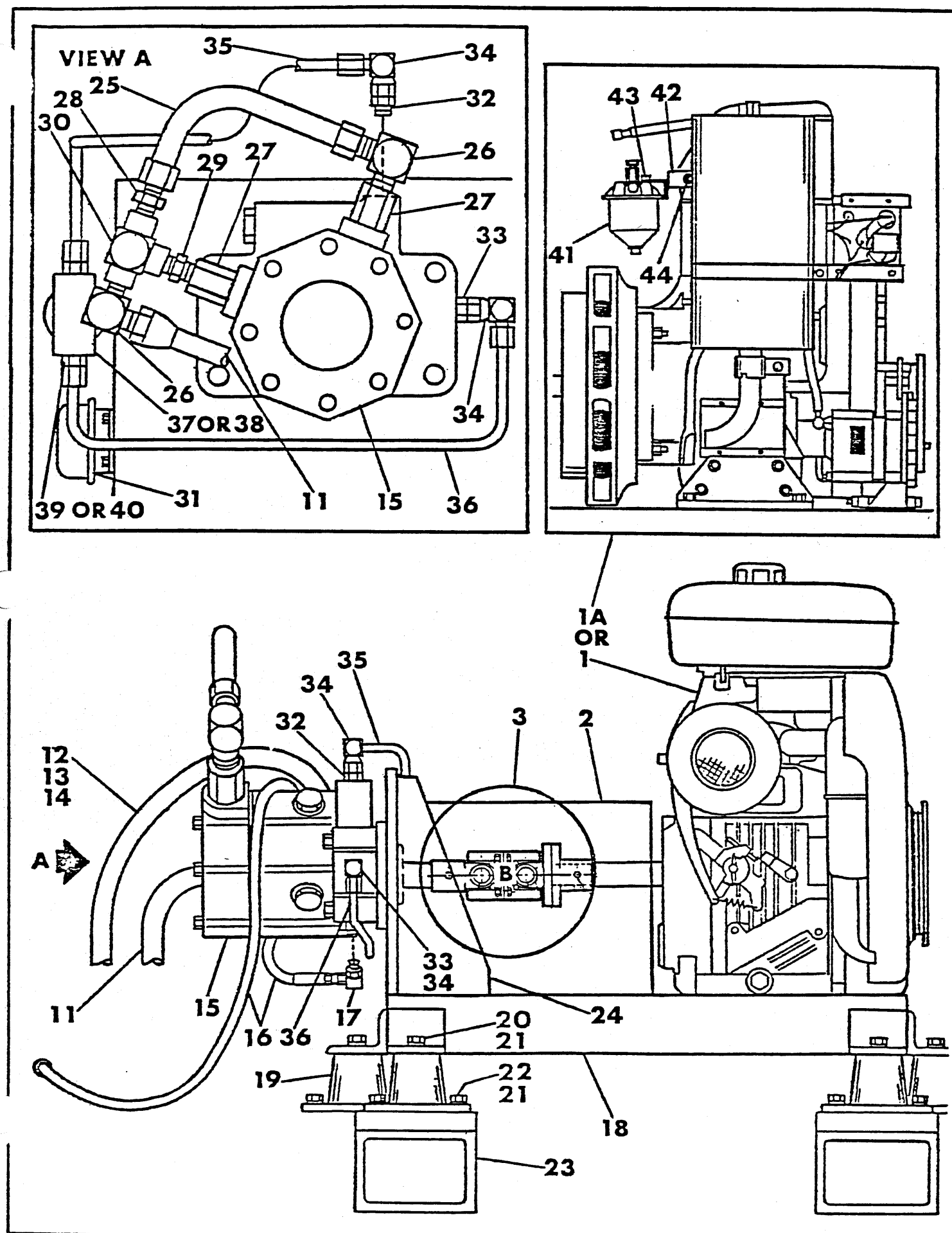
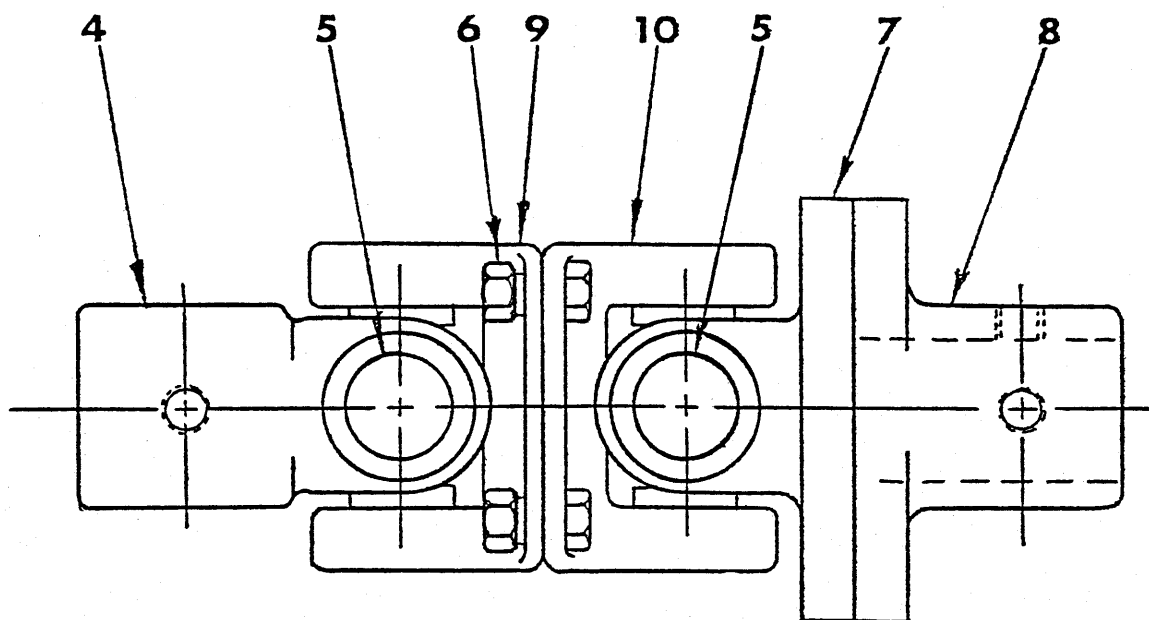


FIGURE 49 - AUXILIARY HYDRAULIC POWER PACK INSTALLATION (OPTION 21648 & 21650)

VIEW B



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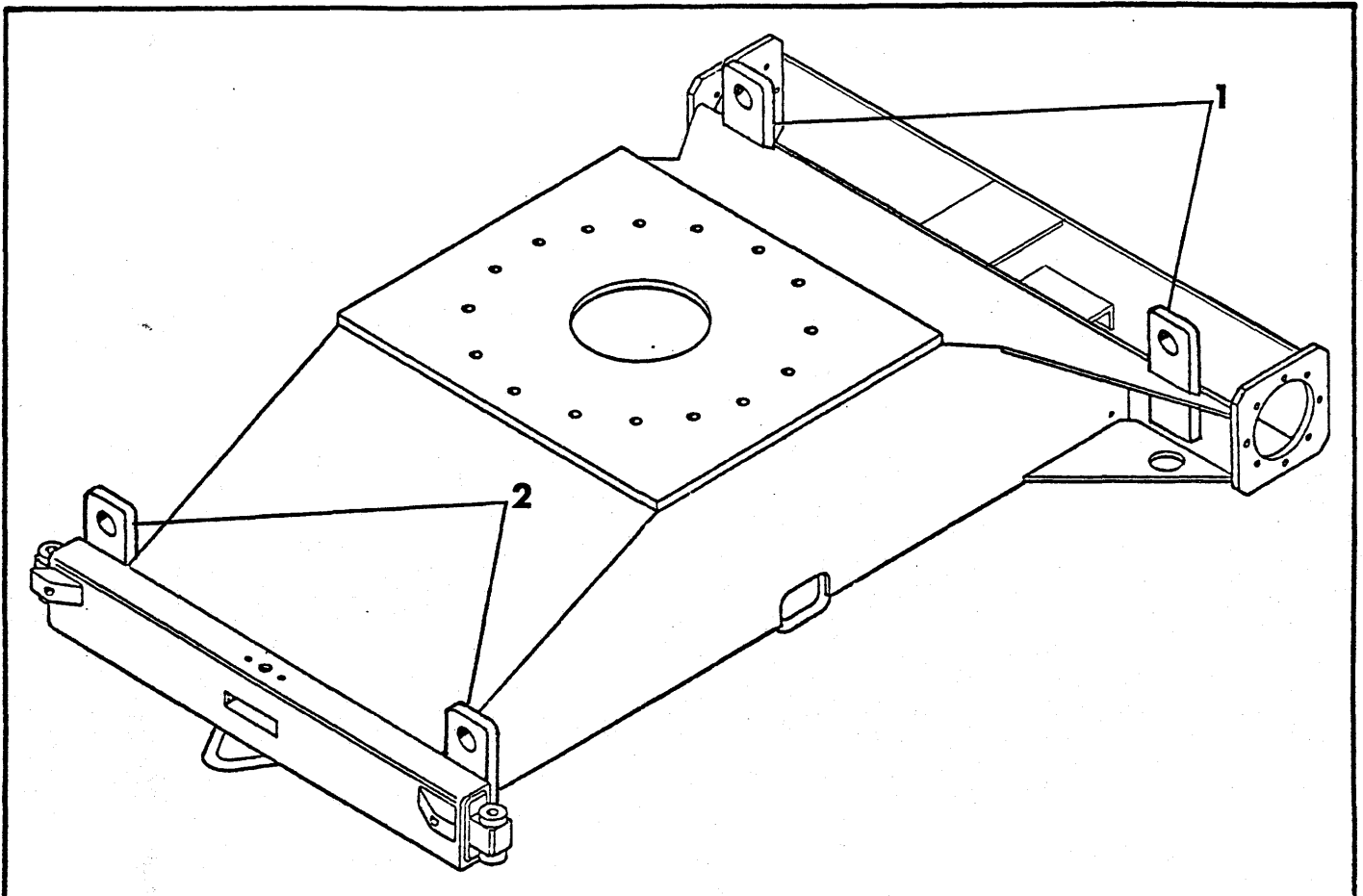
FIGURE 49 - AUXILIARY HYDRAULIC POWER PACK INSTALLATION (OPTION 21648 & 21650)

REF	DESCRIPTION	PART NUMBER	QTY
49-	Auxiliary Hydraulic Power Pack Installation	21648 (Gas) or 21650 (Diesel)	1 1
- 1	Gas Engine	21377	1
- 1A	Diesel Engine	21618	1
- 2	Cover	18788	1
- 3	Piston Pump Drive Line Assembly	21782	1
- 4	End Yoke	2-4-453	1
- 5	Journal Assembly	5-153	2
- 6	Kit	6-73-316	1
- 7	Flange Yoke	2-2-329	1
- 8	Companion Flange	2-1-293 *	1
- 9	Companion Flange	2-2-329	1
-10	Companion Flange	2-2-389	1
-11	Hose Assembly - Suction	FG 1060-KKK	1
-12	Hose Assembly - Pressure	FG 1059-KKK	1
-13	Swivel Elbow	3903-12-12	1
-14	Adapter	0503-8-12	1
-15	Pump	21345	1
-16	Case Drain Hose Assembly	(J.D. Furnished)	1
-17	90° Degree Elbow	(J.D. Furnished)	1
-18	Engine Base	21392	1
-19	Engine Mount	RMD-520	4
-20	Hex Head Capscrew	1/2-13 UNC X 1-1/4	4
-21	Lockwasher	1/2	12
-22	Hex Head Capscrew	1/2-13 UNC X 1	8
-23	Engine Support Bracket	21391	2
-24	Pump Bracket	21393	1
-25	Tube Assembly	3/4	1
-26	90° Elbow	2103-12-12	2
-27	O-Ring Adapter	0502-12-12	2
-28	Adapter	0103-12-12	1
-29	Adapter	0101-12-12	1
-30	Female Tee	02J02-12	1
-31	Relay	1116969	1
-32	O-Ring Adapter	202702-8-4	1
-33	O-Ring Adapter	202702-6-4	1
-34	90° Swivel Elbow	2071-4-4	2
-35	Tube Assembly	1/4	1
-36	Tube Assembly	1/4	1
-37	Solenoid Valve (FPS)	5-06AA-2A	1
-38	Solenoid Valve (FC)	7W31-16T-12	1
-39	Adapter (for FPS)	0103-4-4	2
-40	Adapter (for FC)	0503-4-4	2
-41	Fuel Filter (Cartridge C-1110PB)	Model FBM 1110-PBM	1
-42	Filter Mounting Bracket	25219	1
-43	Hex Head Capscrew	(Furnished w/fuel filter)	2
-44	Socket Head Capscrew	(Furnished w/diesel engine)	2

FIGURE 49 - AUXILIARY HYDRAULIC POWER PACK INSTALLATION (OPTION 21648 & 21650)

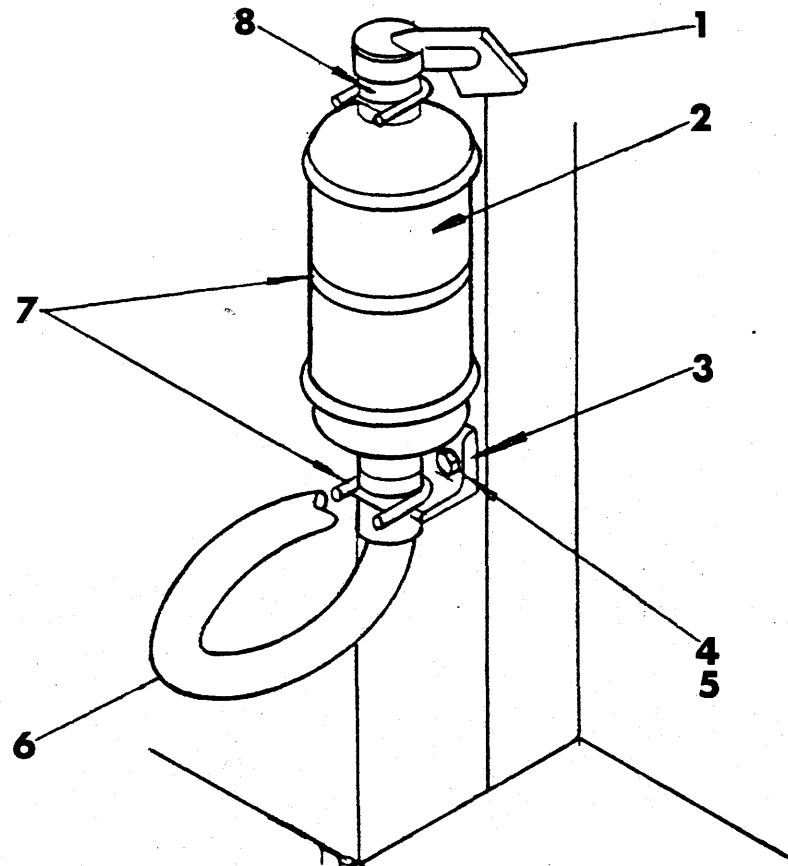
REF	DESCRIPTION	PART NUMBER	QTY
	<p>* 2-1-293 Replaces W27-1-7/17 when drive line assembly 21782 used for emergency power packs.</p>		

FIGURE 54 - LIFTING EYES (OPTION 21651)



REF	DESCRIPTION	PART NUMBER	QTY
54-	Lifting Eyes	21651	4
-1		21651-1	2
-2		21651-2	2

FIGURE 56 - SPARK ARRESTER (OPTION 21385)



REF	DESCRIPTION	PART NUMBER	QTY
56-	Spark Arrester	21385	1
- 1	Rain Cap	35226	1
- 2	Muffler	21390	1
- 3	Muffler Mounting Bracket	21825	1
- 4	Hex Head Capscrew	5/16-18UNC X 3/4	2
- 5	Lockwasher	5/16	2
- 6	Flexible Exhaust Tube Assembly (21824)	(Reference)	1
- 7	Bank, Clamps & Shims	Part of 21390	A/R
- 8	Tube Section	1-3/4 O.D. X GA 12 X 4-1/2 ASTMA513	1

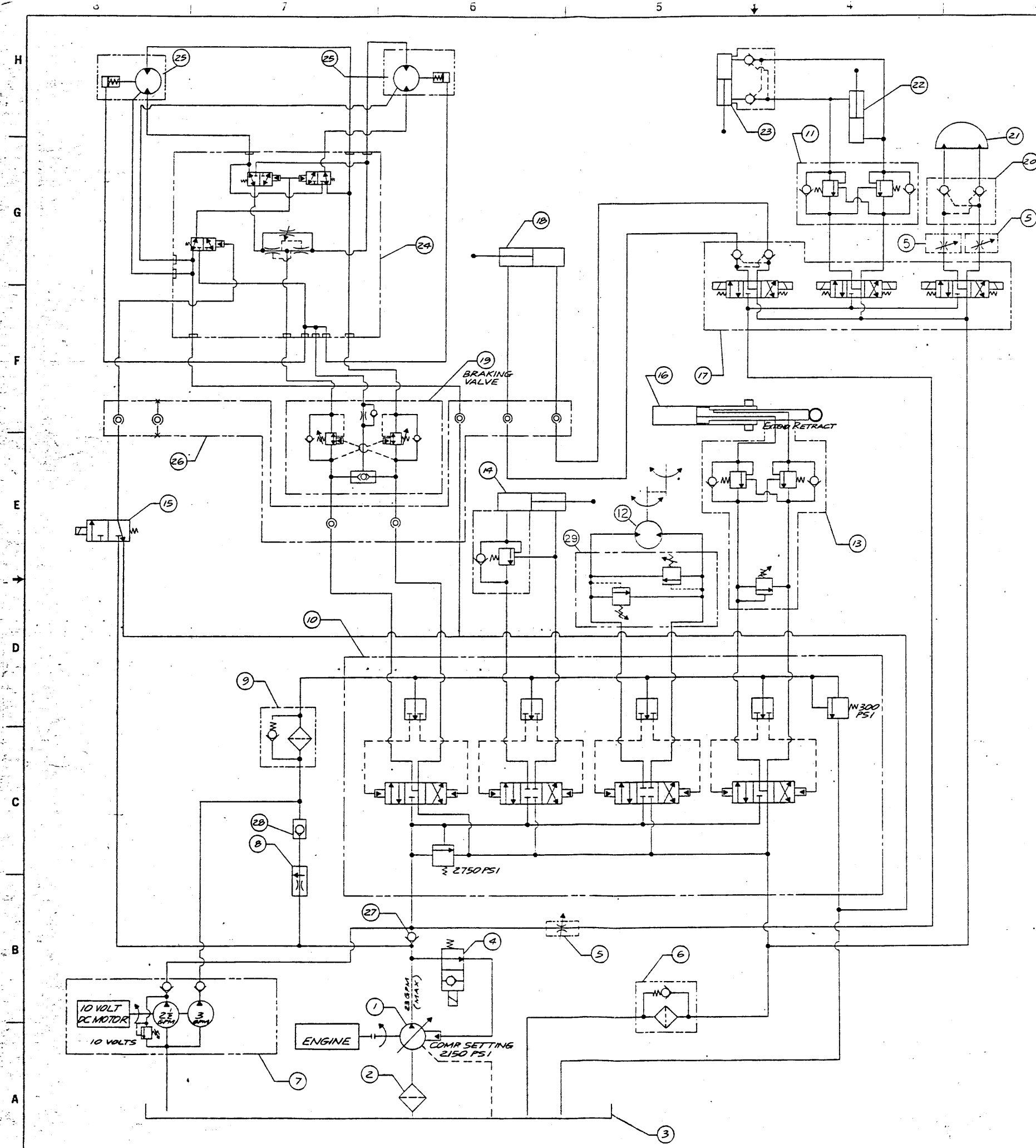



TABLE I

MODEL	TOPPING CYLINDER		800MM EXTENSION CYLINDER	
	CALAWAR No.	LANTEX No.	CALAWAR No.	SIERRA No.
40	40611	4785-LM		
48	40610	4784-LM	40770	
50	40611	4785-LM	40771	
58	40612	5077-LM	40772	
68	40612	5077-LM	40773	

NOTE:
ITEMS 11, 13 CONSISTS OF 2 CARTRIDGES
P/N CBEA-LAN-2900 PSI; SUN HS
CALAYAR # 40105

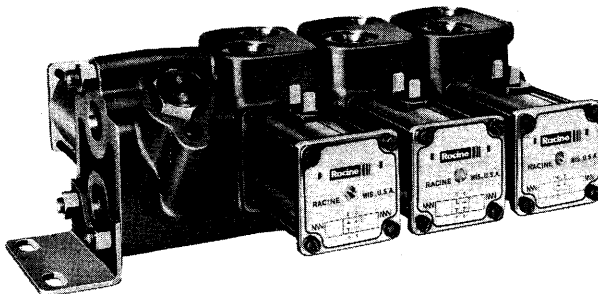
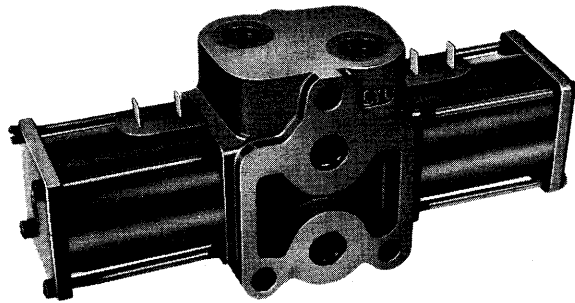
1	29	32763	CROSS RELIEF	RP6C-JAN-YWR, SUN; I200 PSI
1	20	40795	CHECK VALVE	EC-255 DELTROL
1	27	21368	CHECK VALVE	DELTROL #EDC-355
1	26	32554	ROTARY COUPLING	LORENCE #5162-0000
2	25	21568	HYD MOTOR 1/2" BORE	NSI #RSB-045-224-Y2B3I
1	24	40099	DRIVE VALVE ASSY	MODULAR CONTROLS #HED-151D
1	23	40617	SLAVE CYL.	LANTEX #437B-LM; PLOT CHECK VALVE CALAWA #40706/0106/0106/0206
1	22	40003	MASTER CYL	LANTEX #437B-LM
1	21	32735	180° HYD ROTARY ACTUATOR	HYDRATONER # TRI80-01511
1	20	21480	PLOT CHECK VALVE	RACINE # 1606-2FR
1	19	32613	BRACING VALVE	MODULAR CONTROLS #MVS-10412736
1	18	40002	STEERING CYL	LANTEX # 4379-BL
1	17	40078	SOLENOID VALVE	RACINE #916165
1	16	SEE TABLE Z	BOOM EXT CYL	
1	15	21491	SOLENOID VALVE	FLUID CONTROLS #7N41-23-125
1	14	SEE TABLE Z	TOPPING CYL	
1	13	40817	HOLDING VALVE NYADU RELIEF	SUN HYD #8A03-2BU-308 REV.B
1	12	32762	HYD MOTOR	WHITE MOTORS RSHE-1
1	11	40104	HOLDING VALVE	SUN HYD #3BA-LAN1A1-2900 R5.1
1	10	40053	PROX CONT VALVE	BERTEA #250B25-101B
1	9	21475	FILTER	MORGAN RUDKNER #TC-685K-12H
1	8	21472	FLOW CONT VALVE	WATERMANN # 190-2-3-0
1	7	40648	EMERGENCY ELEC MOTOR - PUMP ASSY	WESTON #77L-00000; SLAVE MOTOR # 40649 (WESTON #23A-152") 1/2" PUMP & MOTOR (1/2" FOR 200 PSI) 1/2" PUMP & MOTOR (1/2" FOR 200 PSI)
1	6	32522	FILTER	MICHIGAN FLUID POWER / AMBAC # SAR-28516 (10M ELEMENT)
3	5	21479	NEEDLE VALVE	FINUTROL # NMF-20B
1	4	21465	SOLENOID VALVE	FLUID CONTROLS #7N31-167-12
1	3	21237	HYD RESERVOIR	FLEMING # E-545-2
1	2	21473	SUMP STRAINER	FLOW EET # P50-1-1/2-100
1	1	21478	HYD PUMP (MAIN)	JOHN DEERE #P1001; 2150 TGA SETTINGS

RTY PART NO.	ITEM NO.	PART OF IDENTIFYING NO.	MANUFACTURING OR DESCRIPTION	DATA: SPECIFICATIONS SIZES, NOTES, SUPPLIERS
			UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON:	 AREA 19 SPECIAL CALIFORNIA
			FINISHES FINISHES 22" 2 1/2" 2 1/2" 2 1/2"	
			DRIVEN CHECKED DESIGN APPROVAL NEXT ASSEMBLY MODEL	TITLE HYDRAULIC SCHEMATIC CONFORM MODELS 40, 46, 50, 58, 68 (BERTA AND 723, PRIOR TO SERIAL 734) DATE 10/28/68 BY 40787 B
APPLICATION:			APPROVED 10/28/68 10/28/68	CAL. 10/28/68



fluid power products

REPAIR PARTS



DIRECTIONAL CONTROL VALVES FOUR WAY VALVE 1/4"

3000 PSI
SLEEVELESS
STACKABLE

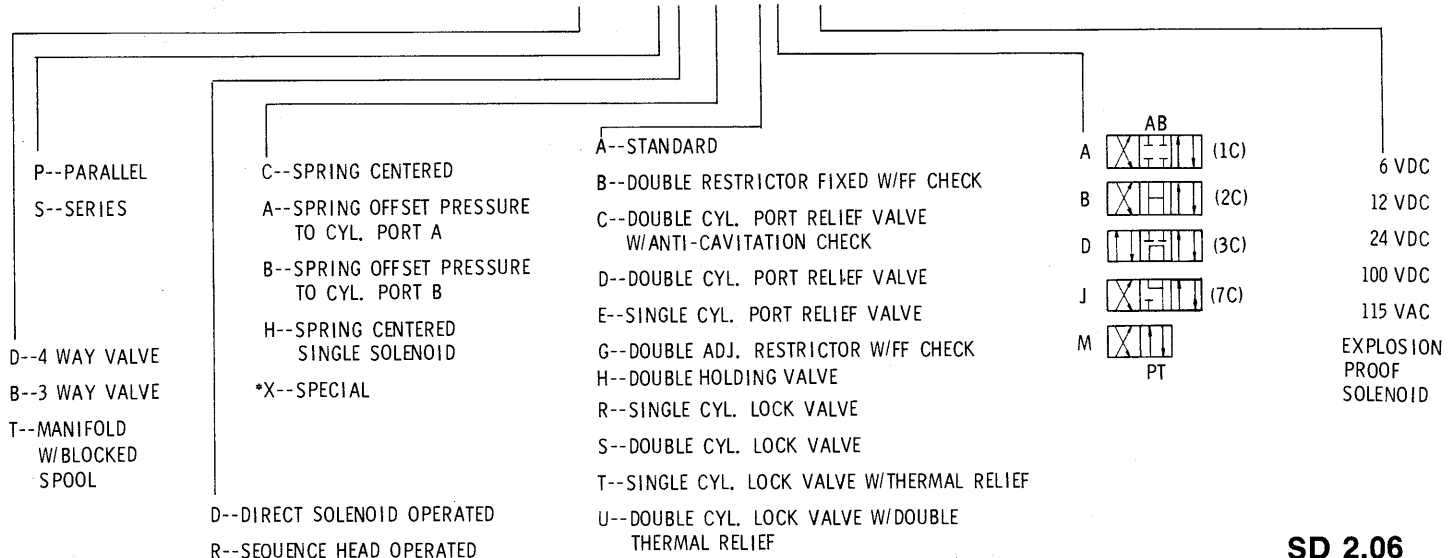
WHEN ORDERING PARTS, FURNISH:

1. COMPLETE CODE NUMBER
2. PARTS REQUIRED
3. SHIPPING INSTRUCTIONS

WRITE FACTORY FOR NEAREST AUTHORIZED
PARTS AND SERVICE CENTER.

VALVE CODING

MD04 - PDNC - AA - *VDC



For engineering data see Bulletin ED 2.06

*CONSULT FACTORY

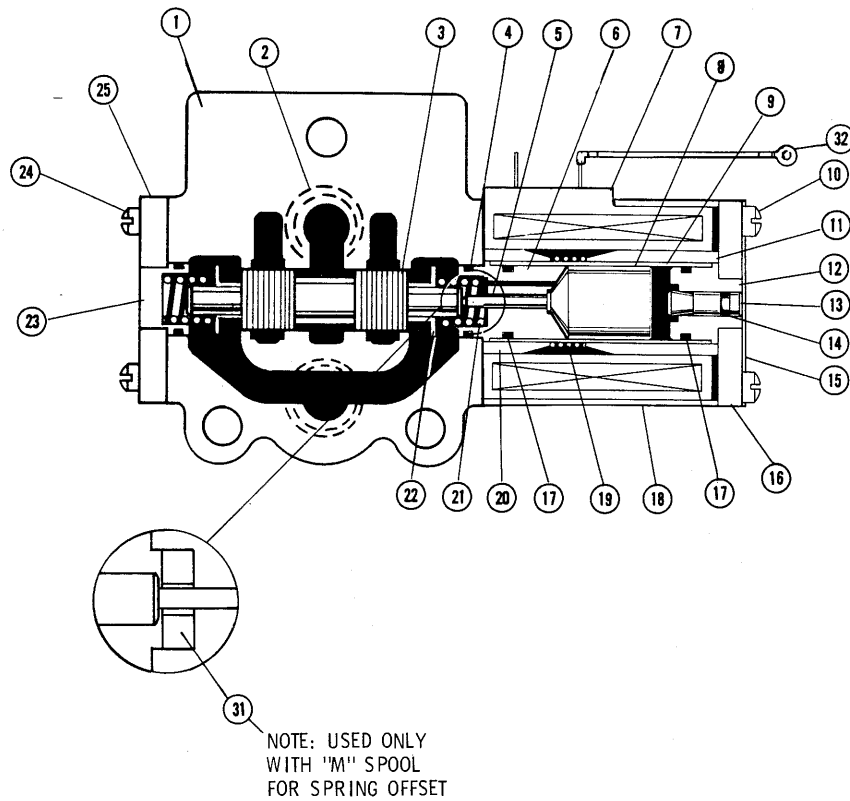
SD 2.06

AUGUST 1979

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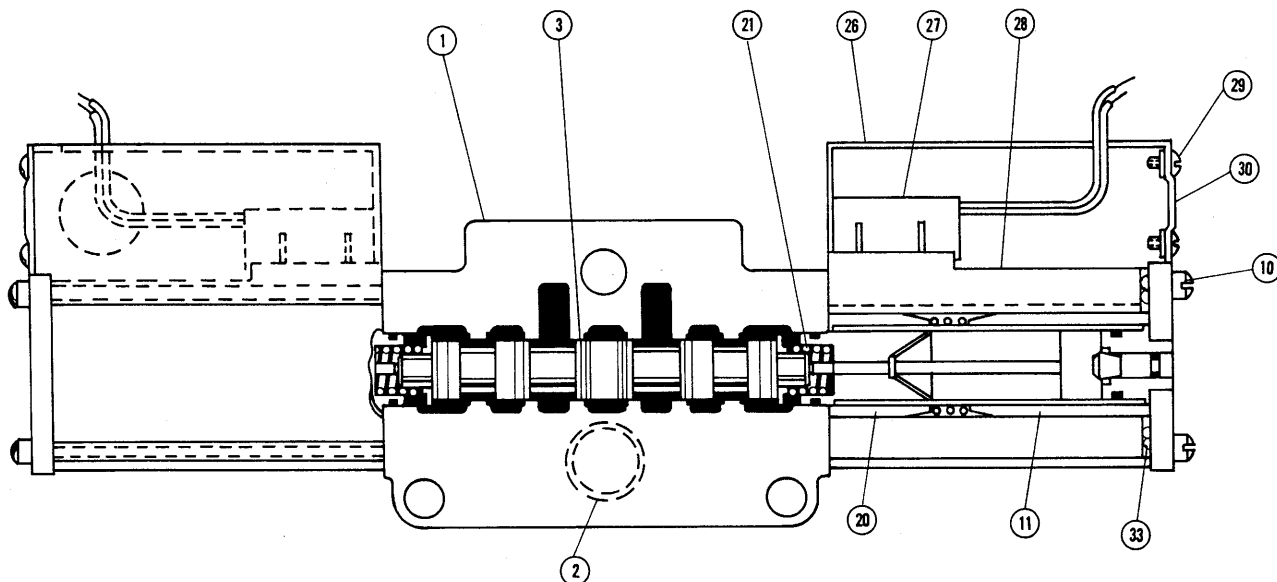
PARALLEL VALVE

SINGLE D.C. SOLENOID



SERIES VALVE

DOUBLE A.C. SOLENOID



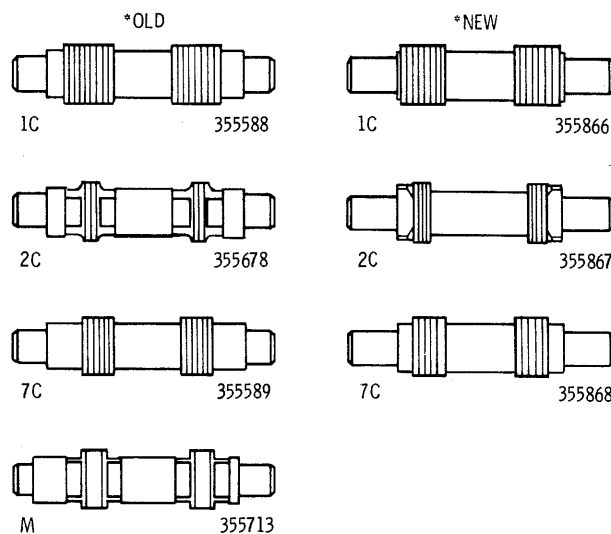
Ref. No.	Part No.	Description	Qty.
1	253207	Series Body, 6 SAE	1
1	253209	Series Body, 6 SAE (Accessory Body)	1
1	253127	Parallel Body, 6 SAE	1
1	253129	Parallel Body, 6 SAE (Accessory Body)	1
1	253128	Parallel Body, 1/4" NPTF	1
1	253130	Parallel Body, 1/4" NPTF (Accessory Body)	1
* 2	407342	O-ring, 1/16 x 11/16 x 13/16	1/2
3	See Spool Chart	Spool	1
* 4	408870	O-ring, 1/16 x 5/8 x 3/4	1/2
5	355296	Push Pin, DC Solenoid	1/2
5	355491	Push Pin, AC Solenoid	1/2
6	355671	Female Cone, DC Solenoid	1/2
6	355674	Female Cone, AC Solenoid	1/2
7	Table #2	Coil, DC	1/2
8	355341	Plunger, DC Solenoid	1/2
8	355478	Plunger, AC Solenoid	1/2
9	355281	Guide Tube, DC Solenoid	1/2
9	355280	Guide Tube, AC Solenoid	1/2
10	493459	Screw, Fillister Hd., #10-24 UNC x 2-15/16 (D. C. Solenoid Only)	4/8
10	493460	Screw, Fillister Hd., #10-24 UNC x 3-7/8 (A. C. Solenoid Only)	4/8
11	355275	Outer Flux Sleeve, DC Solenoid	1/2
11	355277	Outer Flux Sleeve, AC Solenoid	1/2
12	355290	External Push Pin Guide	1/2
13	405964	Actuator Pin, Standard	1/2
13	306769	Actuator Pin, Extended	1/2
*14	407362	Quad Ring, 1/16 x 1/8 x 1/4	1/2
15	493745	Nameplate (Blank)	1/2
16	355292	End Plate	1/2
*17	406460	O-ring, 1/16 x 9/16 x 11/16	2/4
18	355293	Solenoid Case	1/2
19	493428	Spring	1/2
20	355274	Inner Flux Sleeve, DC Solenoid	1/2
20	355276	Inner Flux Sleeve, AC Solenoid	1/2
21	493829	Spring, Parallel Body	1/2
21	493483	Spring, Series Body	1/2
22	493526	Washer, (All Except Spring Offset) Series Only	2
22	355841	Hat Washer, Parallel Only	2
23	355414	Plug Seal	1
24	400995	Screw, Fillister Hd., #10-24 UNC x 5/8	4
25	355415	End Plate	1
26	493543	Wiring Enclosure, AC Solenoid	1/2
27	Table #1	Rectifier	1/2
28	Table #1	Coil, AC	1/2
29	491028	Screw, Pan Hd., #6-32 x 1/4	4/8
30	493543	Cover, Enclosure	1/2
31	355714	Spacer (Spring Offset Only)	1
32	493474	4" Lead Wire W/1/4" Spade Connector	1/2
32	493467	24" Lead Wire W/1/4" Spade Connector	1/2
33	405914	Hubbard Washer (AC Only)	1/2

*Included in Seal Kit 708268

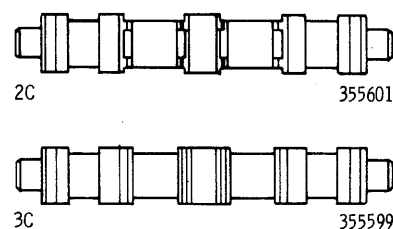
TABLE #1 AC SOLENOID			
Rectifier No.	Coil No.	AC Voltage	Watts
493539	493418	115 VAC	30
493539	493523	115 VAC	55

TABLE #2 SERIES 6 D. C. SOLENOID			
Solenoid Assy. No.	Coil No.	Voltage	
707562	493519	6 VDC	} 'M' Spool Only
707563	493482	12 VDC	
707564	493596	24 VDC	
707565	493522	100 VDC	
706255	493519	6 VDC	
708256	493482	12 VDC	
708257	493596	24 VDC	

SPOOL CHART PARALLEL BODY

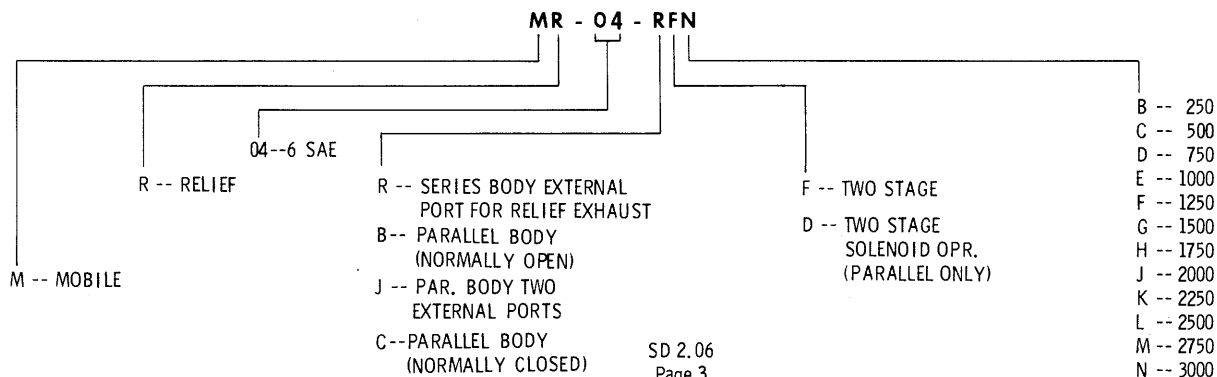


SERIES BODY



*NOTE: New Spool Design uses Hat Washer No. 355841
Old Spool Design uses Washer No. 493526

RELIEF VALVE CODING



michigan fluid power T-line filters for low-pressure systems

Choice of models with
Twin-Life[®] patented
wire cloth dual element
or polymer-coated
"throw-away" paper element.
For 20.69 BAR (300 psi)
operating pressure.

NFPA NATIONAL
FLUID POWER
ASSOCIATION

AMBAC

Industries Incorporated

FLUID POWER SYSTEMS DIVISION

511 South Glenn Avenue • Wheeling, Illinois 60090
Phone: 312-541-3000

T-LINE FILTERS

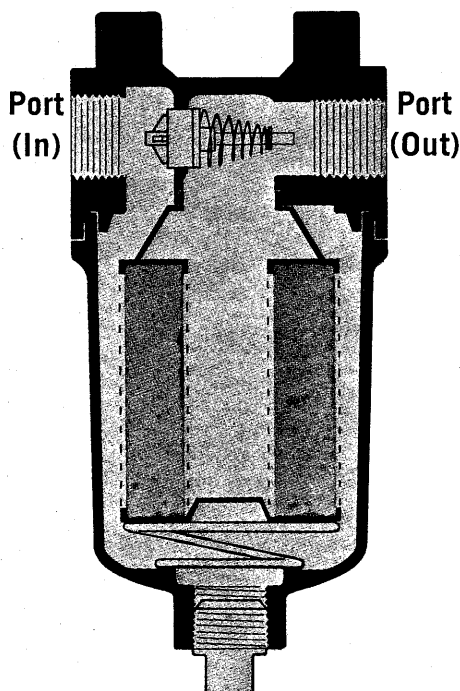
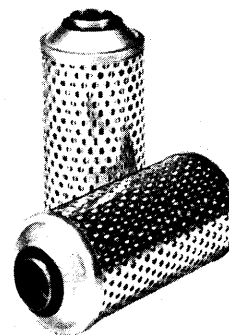
**Maximum protection
for hydraulic, lubrication
and other fluid systems**

Michigan[®] T-line filter assemblies . . . your best protection against damage by contaminants. Choice of precision "throw-away" paper element or "Twin-Life" wire cloth dual-element—each designed to keep your fluid system clean longer for top performance. With up to 20.69 BAR (300 psi) operating pressure, low-maintenance T-Line filters are rated at up to 114 Liter/Min. (30 gpm) flow, depending on allowable pressure drop. In compact installations, less than 25.4 mm (1") disassembly clearance is required to replace or clean the dirty element. Many accessories and options offer added convenience and protection: precision-grade by-pass valve . . . protective magnet . . . vacuum indicators . . . compound pressure gauge . . . Viton seals . . . and top mounting holes.

TC SERIES

**Polymer-coated paper "throw-away" element
assures fine filtration down to 10 microns**

TC Series filters have a high-grade pleated paper element, designed for use with petroleum and most water-base fluids. Element is constructed with corrosion-resistant metal end-caps, protective exterior perforated metal support, and integral gasket for leak-proof sealing. Replacement elements are easily installed for low-cost maintenance.

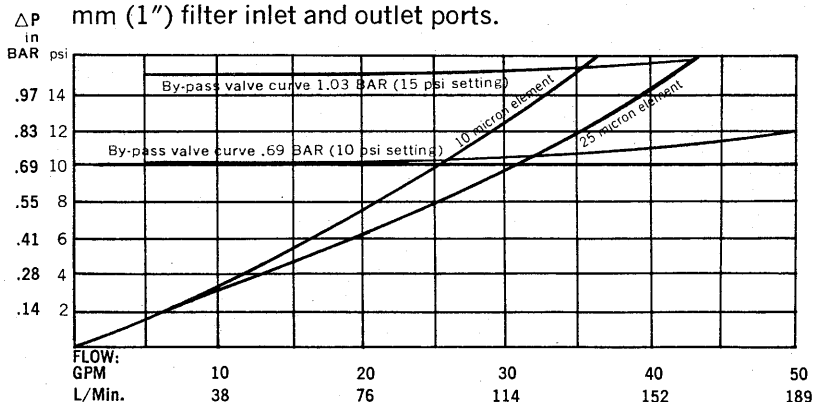


See ordering information on page four for complete order number, by-pass valve setting, connector line size, accessories, and dimensions. By-pass valve is optional.

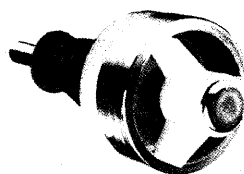
ELEMENT AREA	NOMINAL SIZE PARTICLE RETENTION RATING	
	10 Micron (.0004") .010 MM	25 Micron (.001") .025 MM
2903 sq. cm 450 sq. in.	TC68	TC69
REPLACEMENT PAPER ELEMENT ONLY		
2903 sq. cm 450 sq. in.	C68	C69

Pressure differential/flow characteristics (average)

Flow data shown below was taken from laboratory tests using petroleum-base 225 SSU hydraulic oil at 29.4°C (85°F). Pressure differentials were measured across 25.4 mm (1") filter inlet and outlet ports.



Rugged Michigan[™] T-Line filters provide outstanding performance in critical fluid power and lubrication systems. A wide choice of micron retention ratings meet demanding filtration needs. Choice of port sizes and mounting holes aid easy installation. Precision die-cast construction and advanced design assure economy and convenience. T-Line filters are specified to protect automotive, agricultural, construction, industrial, material handling, chemical, petroleum, machine tool, processing, and automation equipment fluid systems.

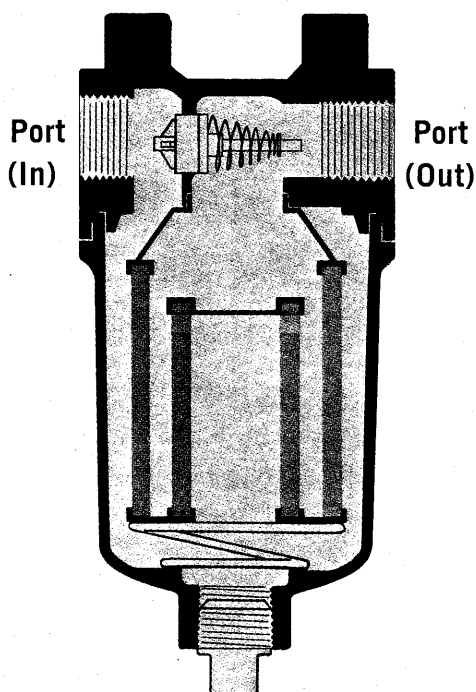
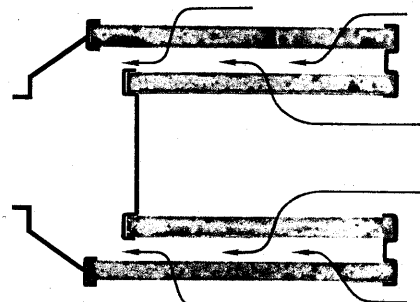


To guard your system components against washing of collected contaminants downstream, Michigan[™] filters feature an all metal by-pass valve. Self-contained in the filter head, this optional by-pass valve provides straight-through flow. Available standard valve settings range from pressure differential of .10 BAR (1.5 PSID) to 1.72 BAR (25 PSID).

TF SERIES

"Twin-Life" wire cloth dual-element has up to 50% more dirt-holding capacity

TF Series filters feature the patented "Twin-Life" wire cloth dual-element—actually two elements mounted coaxially in a single assembly. This unique dual-element provides 50% longer life between cleanings, because element area is 50% larger than comparable single-edge elements. Take-apart construction allows easy maintenance cleaning with less downtime.

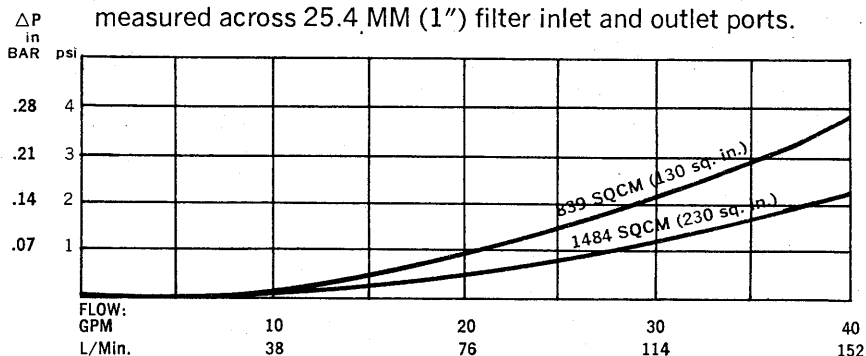


See ordering information on page four for complete order number, by-pass valve setting, connector line size, protective magnet, other accessories, and dimensions. By-pass valve is optional.

DUAL ELEMENT AREA	NOMINAL SIZE PARTICLE RETENTION RATING			
	40 Micron 325 Mesh (.0016") (.040 MM)	74 Micron 200 Mesh (.0029") (.074 MM)	150 Micron 100 Mesh (.0060") (.140 MM)C	262 Micron 60 Mesh (.0103") (.262 MM)
839 sq.cm 130 sq. in.	TF22	TF23	TF25	TF27
1484 sq. cm 230 sq. in.	TF42	TF43	TF45	TF47

Pressure-differential/flow characteristics (average)

Flow data shown below was taken from laboratory tests of a 140 micron element using petroleum-base 225 SSU hydraulic oil at 29.4°C (85°F). Pressure differentials were measured across 25.4 MM (1") filter inlet and outlet ports.

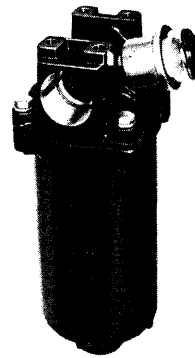


AMBAC Industries Incorporated
FLUID POWER SYSTEMS DIVISION

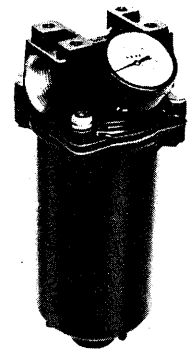
Vacuum indicator or pressure gauge shows element condition at a glance

Visual signal or remote signal vacuum indicators monitor changing system conditions when mounted on Michigan[®] T-Line filters — lets you know when to clean or change the element. Write for indicator Bulletin #2-5300-1, covering complete specifications.

Compound pressure gauge indicates psi increment vacuum conditions in inches Hg. and pressure conditions in two psi increments up to 6.9 BAR (100 psi).



T-Line filter with Red-Alert[™] visual indicator



T-Line filter with compound pressure gauge

ORDERING INFORMATION

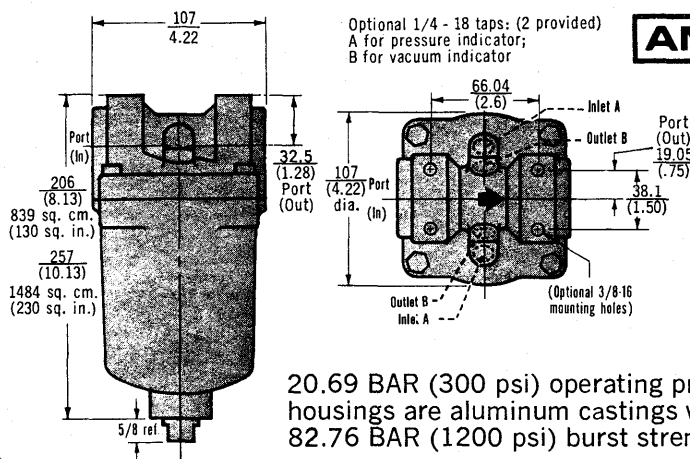
For T-Line filter assembly order number, fill-in boxes below ...

Typical ordering number: TC68GA20GV

10 micron, paper element 1.72 BAR (25 psid) by-pass valve, pressure taps, (2), 1 1/4 NPTF, compound pressure gauge, and Viton seals.

ELEMENT TYPE	OPTIONAL BY-PASS VALVE	OPTIONAL TAPS	CONNECTOR LINE SIZE (N.P.T.F.)	OPTIONAL FEATURES
Wire Cloth: (130 sq. in.) 839 sq. cm 40 Micron 74 Micron 150 Micron 262 Micron (230 sq. in.) 1484 sq. cm 40 Micron 74 Micron 150 Micron 262 Micron Paper: (450 sq. in.) 2903 sq. cm 10 Micron 25 Micron	No Valve With Valve: BAR PSID .10 1.5 .21 3 .34 5 .69 10 1.03 15 1.72 25	No taps With taps: Pressure (2) Vacuum (2) (See drawing below)	3/4-14 1 -11 1/2 1 1/4-11 1/2	"Floater" Vacuum Indicator Compound Pressure Gauge Top Mounting Holes "Locker" Vacuum Indicator Viton Seals Protective Magnet (for use with TF Series only)
To order replacement elements, use numbers shown above, i.e. "F22" and "C68."				
Ordering Number	T			

(Specifications subject to change without notice.)



20.69 BAR (300 psi) operating pressure, housings are aluminum castings with 82.76 BAR (1200 psi) burst strength rating.

AMBAC Industries Incorporated

FLUID POWER SYSTEMS DIVISION

511 South Glenn Avenue • Wheeling, Illinois 60090
Phone: 312-541-3000

michigan fluid power spin-a-filter

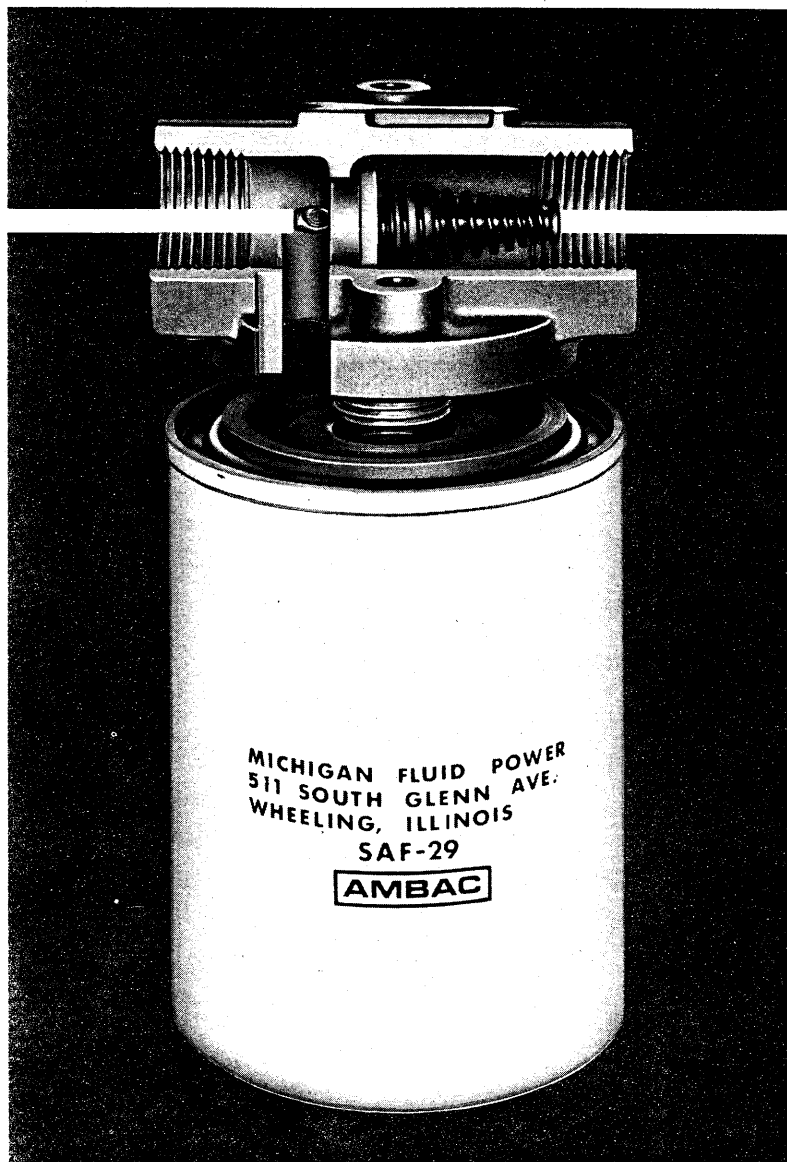
SAF 20 SERIES

Twist off the old element. Twist on the new. No bolts to remove. No time-consuming cleaning operations. Takes less than a minute to change a Spin-A-Filter element.

Disposable filter element pays for itself with lower maintenance and downtime costs. Designed for most return line applications up to 76 L/Min. (20 GPM). Also for low flow, critical suction line applications. For use with petroleum-based oils in industrial and mobile equipment operations.

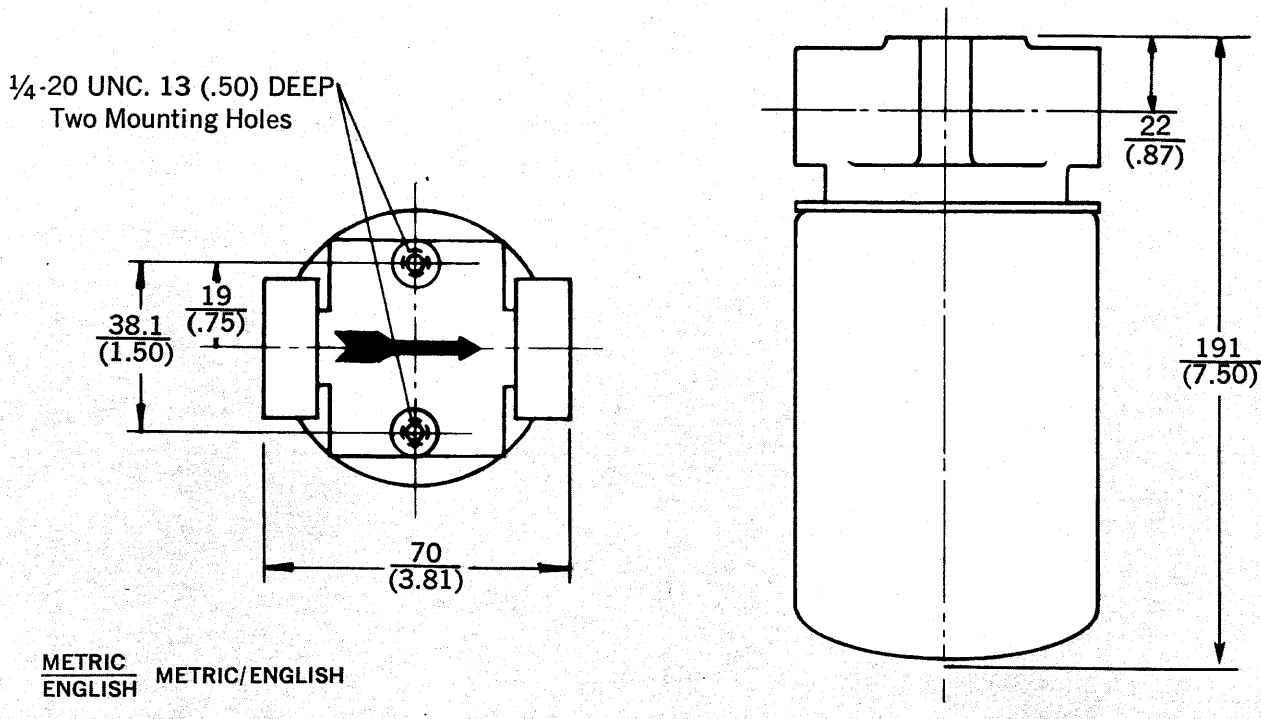
Isolated by-pass valve in the cast aluminum housing head protects element against line surges. 10 and 25 micron elements available as standard. $\frac{3}{4}$ " and 1" NPTF port sizes. Two other series available: (SAF50 and TAF50).

Please consult manufacturer for details:
Michigan Fluid Power
511 South Glenn Avenue
Wheeling, Illinois 60090.
Phone: (312) 541-3000



AMBAC Industries Incorporated
FLUID POWER SYSTEMS DIVISION

dimensional data



engineering data

Port sizes 3/4" and 1" NPTF
By-pass valve setting, factory set... 1.7 BAR (25 PSID)
Nominal size particle retention rating 10 & 25 MICRON
Operating pressure..... 6.9 BAR (100 PSI) MAX.
Operating temperature 121°C (+250°F) MAX.
Performance 160 SSU @ 37.8°C (100°F)

FLOW		AVERAGE PRESSURE DROP			
L/MIN	GPM	25 MICRON		10 MICRON	
19	5	.04 BAR	.6 PSI	.14 BAR	2.0 PSI
38	10	.23 BAR	3.4 PSI	.38 BAR	5.5 PSI
57	15	.43 BAR	6.3 PSI	.68 BAR	9.9 PSI
76	20	.69 BAR	10.0 PSI	1.01 BAR	14.7 PSI

ordering information

25 MICRON

Filter Assembly Model SAF29G12 for 3/4" NPTF
Filter Assembly Model SAF29G16 for 1" NPTF
Replacement element model S-29

10 MICRON

Filter Assembly Model SAF28G12 for 3/4" NPTF
Filter Assembly Model SAF28G16 for 1" NPTF
Replacement element model S-28

T-LINE FILTER REPLACEMENT PARTS LIST

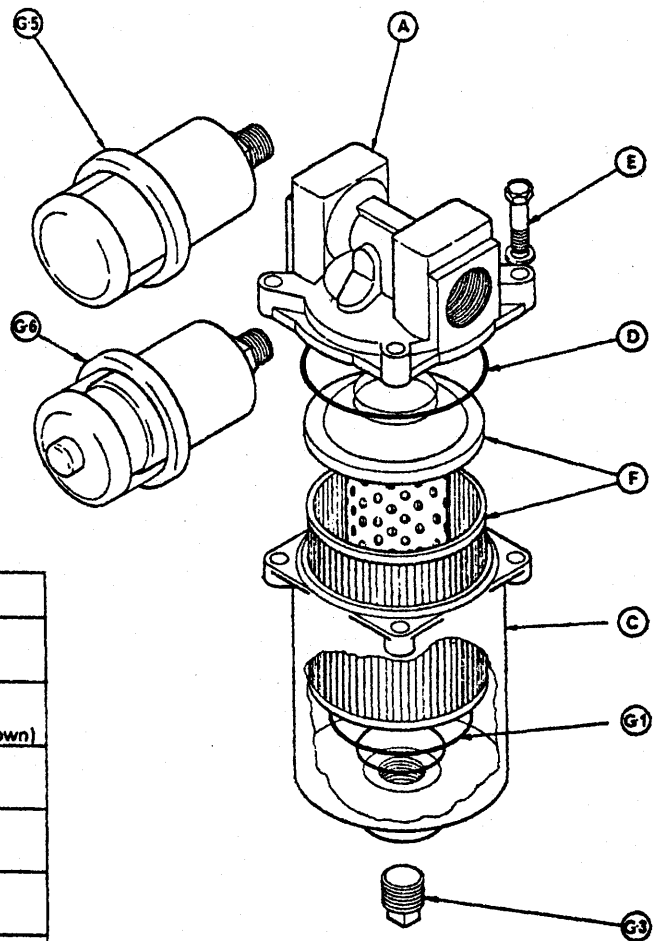
for TC Series (Paper Element) and TF Series (Wire Cloth Element)

DESCRIPTION	SPECIFICATION	PART NUMBER	SERIES	LIST PRICE
A. HEAD ASSEMBLY Specify if required: 1. By-pass valve setting 2. Vacuum or pressure taps * Special Order	½"-14 NPTF	200500	ALL	
	¾"-14 NPTF	200165		
	1-11½ NPTF	200166		
	1¼-11½ NPTF	200167		
	* 1-1/16 Straight Thd.	200168		
	* 1-3/16 Straight Thd.	200169		
	* 1-5/16 Straight Thd.	200170		
B. BY-PASS VALVE ASSEMBLY (Factory installed; please specify head assembly part number.)	1½ psid	"A"	ALL	
	3 psid	"B"		
	5 psid	"C"		
	10 psid	"E"		
	15 psid	"F"		
	25 psid	"G"		
C. BOWL	8.13" x 4.22" (inc. head)	200147	TF20 TF40/All TC	
	10.13" x 4.22" (inc. head)	200148		
D. BOWL SEAL	Buna-N	200590	ALL	
	Butyl	201832		
	Viton	201831		
E. BOLT	5/16" x 1¼" bolts (4)	900478	ALL	set (4)
	5/16" lock washers (4)	901007		set (4)
F. ELEMENT	Wire cloth (145 sq. in.):			
	40 micron	F22	TF22	
	74 micron	F23	TF23	
	140 micron	F25	TF25	
	262 micron	F27	TF27	
	Wire cloth (250 sq. in.):			
	40 micron	F42	TF42	
	74 micron	F43	TF43	
	140 micron	F45	TF45	
	262 micron	F47	TF47	
	Paper (450 sq. in.):			
	10 micron	C68	TC68	
	25 micron	C69	TC69	
	Buna-N seal	201651	ALL TC	
G.	1 - Element spring	200070	ALL TF	
		200475	ALL TC	
	2 - "X" magnet	200189	ALL TF	
	3 - ¾" drain plug	Std.	ALL	
	4 - LP Indicator		ALL	
	5 - "Floater" vacuum indicator	MF 360	ALL	
	6 - "Locker" vacuum indicator	ML 360	ALL	

(Specifications subject to change without notice.)

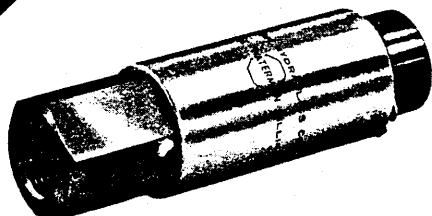
MICHIGAN[®] T-LINE FILTER REPLACEMENT PARTS LIST

for TC Series (Paper Element) and TF Series (Wire Cloth Element)

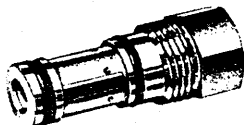


KEY	DESCRIPTION
A	Head assembly
B	By-pass valve assembly (not shown)
C	Bowl
D	Bowl seal
E	Bolt
F	Element
G	1 - Element spring
	2 - "X" magnet (not shown)
	3 - 3/4" drain plug
	5 - "Floater" vacuum indicator
	6 - "Locker" vacuum indicator

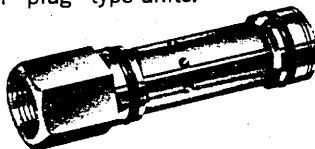
WATERMAN



**MAXIMUM RECOMMENDED
SYSTEM PRESSURE
3000 or 5000 psi**

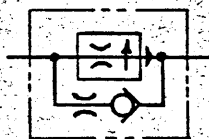


This type of valve is available in small "cart-ridge" or "plug" type units.



Advantageous in applications where their use can save space, eliminate external plumbing, or make a more compact, neater installation.

Contact factory, giving your approximate size and flow rate needed.



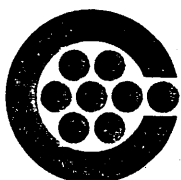
PRESSURE COMPENSATED

Fixed FLOW CONTROL VALVES

A simple, compact unit to control hydraulic power by limiting outlet flow in the direction indicated by the arrow. Optimum flow rate can be selected for the job conditions. This valve will maintain the flow selected regardless of varying system pressures created by different loads.

In the controlled flow direction the valves are pressure compensated over all of the specified differential pressure range. Differential pressure changes affect the internal control area, which in turn limits flow to the required rate. (See information sheet G1 for more detailed information on the principle of operation.) Flow in the reverse direction is uncontrolled. If it is necessary to control flow in both directions, at either the same or different flow rates, the Series 1420 valves shown on Sheet FF9 can be used.

Installation in one of the lines of the hydraulic circuit is fast and easy, and the valve is just slightly larger than the line itself. This product is available in a very wide variety of flow capacities, port sizes and pressure ranges. Details and specifications are shown on the inner pages.



WATERMAN HYDRAULICS

A COMPONETROL COMPANY

6565 WEST HOWARD STREET, CHICAGO, ILLINOIS 60648 / PHONE 312/792-2450 / TELEX: 72-4489

FLOW CONTROLS-FIXED



REPLACES FF1 AND FF2



MI
SE

ALL 19
EXCEPT
AN "S

ANY 19
WI
"SS"

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Press
(100 SS

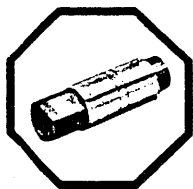
Flow
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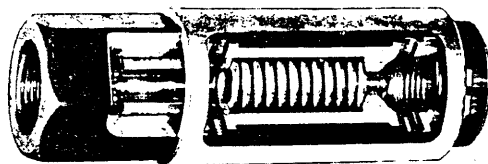
SPECIAL



Series 190



CUTAWAY VIEW OF BASIC SERIES 190



Slight internal parts changes are made to give performance changes for some of the models listed.

All valves are individually calibrated and tested to assure conformance to published data for the specific model.

Materials

MODEL SERIES	BODY	PISTON	SLEEVE	REMARKS
ALL 190 MODELS EXCEPT THOSE WITH AN "SS" CODE	ANODIZED ALUMINUM ALLOY	ALUMINUM ALLOY	CADMIUM PLATED STEEL	GENERAL PURPOSE.
ANY 190 MODELS WITH AN "SS" CODE	TYPE 303 STAINLESS	TYPE 316 STAINLESS CHROME PLATED	TYPE 316 STAINLESS	ADAPTABLE FOR MILDLY CORROSIVE CONDITIONS.
1908	STEEL	STEEL	CADMIUM PLATED STEEL	HIGH PRESSURE GENERAL PURPOSE. INCLUDES TEFLON BACK-UP RINGS.
1477	ANODIZED ALUMINUM ALLOY	ALUMINUM ALLOY	ANODIZED ALUMINUM ALLOY	HAS MIL-SPEC. ANODIZE MEETING SALT SPRAY TEST REQUIREMENTS. INCLUDES TEFLON BACK-UP RINGS.

Reverse Pressure Drop (100 SSU OIL)

Pressure drop at up to controlled flow rate in the reverse flow direction is approximately the same as in the controlled flow direction. At $1\frac{1}{2}$ times the controlled flow rate, reverse pressure drop will be approxi-

mately 160 psi for the 70 to 3000 psi differential pressure range. If flow in reverse direction will be near or above this rate, we recommend Series 194 Flow Controls, Sheet FF3.

Flow Tolerances

NOMINAL CONTROLLED FLOW RATE, GPM
TOLERANCE

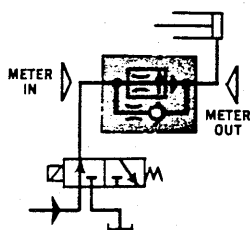
0.1 to 0.49

0.5 to 1.49

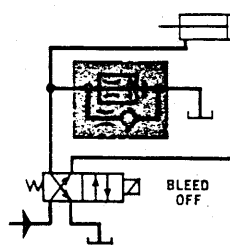
1.5 and up

Tolerances are maximums over the full differential pressure range; will be less if pressure range is less. Can be made to closer tolerances for specific applications.

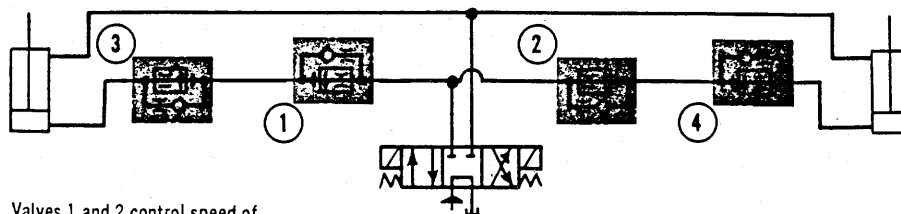
Typical Circuits



Arrows show controlled flow direction thru flow control. Reverse direction for different circuit. Meter-in circuit gives precise control for extension of single-acting cylinder; excess flow dumped at relief valve setting. If retraction is more important, reverse the flow control direction for meter-out.



Pump works at pressure the actuator requires, with best efficiency, since only work resistance need be overcome. Flow is regulated by diverting portion of pump output thru flow control valve rather than relief valve. Accuracy changes if pump output changes since fluid bled off remains constant.



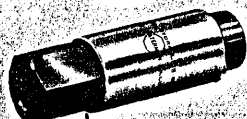
Valves 1 and 2 control speed of cylinders when extending; valves 3 and 4 control cylinder speed when retracting.

MUST BE A NON-THROTTLING TYPE

Combined flow of valves 1 and 2, or 3 and 4, must be less than pump output.

SPECIALISTS IN FLUID POWER CONTROL FOR VIRTUALLY ALL INDUSTRIES • REPRESENTATIVES IN ALL PRINCIPAL CITIES





PRESSURE COMPENSATED **Fixed FLOW CONTROL VALVES** DIFFERENTIAL PRESSURE RANGE, PSI

PORTS	SIZE	TYPE	25 to 250 (Maximum System Pressure 3000 PSI)				70 to 3000				70 to 5000		WEIGHT LBS. ALUMINUM MODELS
			The basic model for low pressure applications.	Use in sets of two or more for extra precise control. Tolerance on actuator synchronization is within $\pm 2\%$.	Varies from basic model only in type of materials used in construction, as detailed in table.		The basic model for medium pressure applications.	Use in sets of two or more for extra precise control. Tolerance on actuator synchronization is within $\pm 2\%$.	Varies from basic model only in type of materials used in construction, as detailed in table.	"Dashpot" piston counteracts uneven loading which might cause instability. Can also prevent "hunting" or oscillation sometimes caused by fluid motors.	The basic model for high pressure applications.	Use in sets of two or more for extra precise control. Tolerance on actuator synchronization is within $\pm 2\%$. Constructed of steel.	
PIPE	1/4"	NPTF	190L-2-*	190AL-2-*	1908L-2-*	190LSS-2-*	190-2-*	190A-2-*	190SS-2-*	—	1908-2-*	1908A-2-*	0.3
	3/8"	NPTF	190L-3-*	190AL-3-*	1908L-3-*	190LSS-3-*	190-3-*	190A-3-*	190SS-3-*	190D-3-*	1908-3-*	1908A-3-*	0.4
	1/2"	NPTF	190L-4-*	190AL-4-*	1908L-4-*	190LSS-4-*	190-4-*	190A-4-*	190SS-4-*	190D-4-*	1908-4-*	1908A-4-*	0.9
	3/4"	NPTF	190L-6-*	190AL-6-*	1908L-6-*	190LSS-6-*	190-6-*	190A-6-*	190SS-6-*	190D-6-*	1908-6-*	1908A-6-*	1.3
	1"	NPTF	190L-8-*	190AL-8-*	1908L-8-*	190LSS-8-*	190-8-*	190A-8-*	190SS-8-*	190D-8-*	1908-8-*	1908A-8-*	2.0
TUBE	1 1/2"	NPTF	190L-12-*	190AL-12-*	—	—	190-12-*	190A-12-*	—	—	—	—	7.3
	1/4"	SAE	190LT-4-*	190ALT-4-*	1908LT-4-*	190LSST-4-*	190T-4-*	190AT-4-*	190SST-4-*	—	1908T-4-*	1908AT-4-*	0.3
	3/8"	MS	1477L-4-*	1477AL-4-*	—	190LMSS-4-*	1477-4-*	1477A-4-*	190MSS-4-*	—	—	—	0.3
	1/2"	SAE	190LT-6-*	190ALT-6-*	1908LT-6-*	190LSST-6-*	190T-6-*	190AT-6-*	190SST-6-*	—	1908T-6-*	1908AT-6-*	0.4
	3/4"	MS	1477L-6-*	1477AL-6-*	—	190LMSS-6-*	1477-6-*	1477A-6-*	190MSS-6-*	1477D-6-*	—	—	0.4
	1"	SAE	190LT-8-*	190ALT-8-*	1908LT-8-*	190LSST-8-*	190T-8-*	190AT-8-*	190SST-8-*	190DT-8-*	1908T-8-*	1908AT-8-*	0.4
	1 1/2"	MS	1477L-8-*	1477AL-8-*	—	190LMSS-8-*	1477-8-*	1477A-8-*	190MSS-8-*	1477D-8-*	—	—	0.4
	2"	SAE	190LT-10-*	190ALT-10-*	1908LT-10-*	190LSST-10-*	190T-10-*	190AT-10-*	190SST-10-*	190DT-10-*	1908T-10-*	1908AT-10-*	0.9
	2 1/2"	MS	1477L-10-*	1477AL-10-*	—	190LMSS-10-*	1477-10-*	1477A-10-*	190MSS-10-*	1477D-10-*	—	—	0.9
	3"	SAE	190LT-12-*	190ALT-12-*	1908LT-12-*	190LSST-12-*	190T-12-*	190AT-12-*	190SST-12-*	190DT-12-*	1908T-12-*	1908AT-12-*	1.3
	3 1/2"	MS	1477L-12-*	1477AL-12-*	—	190LMSS-12-*	1477-12-*	1477A-12-*	190MSS-12-*	1477D-12-*	—	—	1.3
	4"	SAE	190LT-16-*	190ALT-16-*	1908LT-16-*	190LSST-16-*	190T-16-*	190AT-16-*	190SST-16-*	190DT-16-*	1908T-16-*	1908AT-16-*	2.0
	4 1/2"	MS	—	—	—	190LMSS-16-*	—	—	190MSS-16-*	—	—	—	2.0

*NOTE

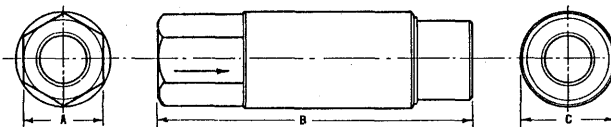
The * in Model Numbers above must be replaced with a last dash number to designate YOUR DESIRED FIXED CONTROLLED FLOW RATE IN GPM, within the recommended capacity for each size shown.

LINE SIZE		RECOMMENDED CAPACITY GPM	
PIPE	TUBE	ANY MODEL WITH "1"	ALL MODELS WITHOUT "1"
—2 1/4"	—4 1/4"	0.1 to 2.5	0.1 to 5.0
—3 3/8"	—8 1/2"	0.1 to 4.5	0.1 to 9.0
—4 1/2"	—10 3/4"	0.5 to 7.5	0.5 to 15.0
—6 3/4"	—12 3/4"	1.0 to 15.0	1.0 to 30.0
—8 1"	—16 1"	2.0 to 25.0	2.0 to 50.0
—12 1 1/2"	—24 1 1/2"	5.0 to 50.0	5.0 to 100.0

In some cases more fluid can be controlled by the valve if a sacrifice in pressure drop and/or tolerance is permissible.

For all valves with "A" in model number, specify quantity in a working set, minimum and maximum inlet and outlet pressures, in addition to controlled flow rate.

DIMENSIONS



PIPE THREAD MODELS			NPTF SERIES				TUBE THREAD MODELS				SAE SERIES			MS SERIES (AND 10050)		
PIPE SIZE	SIZE DASH NUMBER	THREAD SIZE	190 190L 1908A	190A 190SS 1908L	190AL 190LSS 1908	1908	TUBE SIZE	SIZE DASH NUMBER	THREAD SIZE	190T 190LT 1908AT	190AT 190SST 1908LT	190ALT 190LST 1908T	1908T 190MSS 190LMSS	1477 1477D	1477A 1477L	1477AL
DIMENSIONS			A HEX.			B	A HEX.			A HEX.			B	A HEX.		
1/4"	—2	1/4-18	0.81	3.50	1.00	—	1/4"	—4	1/4-20	0.88	3.19	1.00	—	—	—	—
3/8"	—3	3/8-18	0.88	4.16	1.13	—	3/8"	—6	3/8-18	0.88	3.81	1.13	0.88	3.81	1.00	—
1/2"	—4	1/2-14	1.25	5.00	1.50	—	1/2"	—8	1/2-16	1.06	4.13	1.25	1.06	4.13	1.31	—
3/4"	—6	3/4-14	1.50	5.38	1.75	—	3/4"	—10	3/4-14	1.25	5.25	1.50	1.25	5.25	1.38	—
1"	—8	1-11 1/2	1.75	6.63	2.00	—	1"	—12	1 1/4-12	1.50	5.88	1.75	1.50	5.88	1.69	—
1 1/2"	—12	1 1/2-11 1/2	2.50(1)	8.50	3.25	—	1 1/2"	—16	1 1/2-12	1.75	6.88	2.00	—	—	—	—

(1) DISTANCE ACROSS WRENCH FLATS



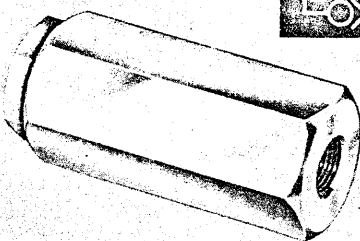
Pressure Compensated
Constant Flow Valves

Pressure Compensated Constant Flow Valves (Hydraulic Only)

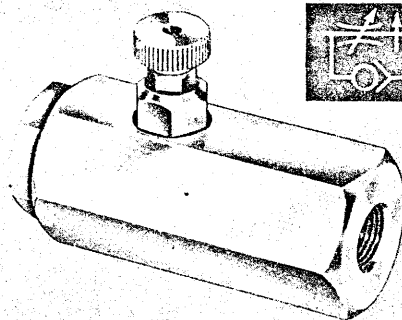
- MAINTAINS ACCURATE CONSTANT FLOW AT PRESSURES UP TO 3000 PSI (NON-SHOCK SERVICE)
- ADJUSTABLE AND NON-ADJUSTABLE (FACTORY-SET FLOW) UNITS
- FREE REVERSE FLOW FOR MAXIMUM RETURN FLOW WITH MINIMUM PRESSURE DROP



Series 3
MINIATURE STANDARD



Series 4
STANDARD WITH
FREE REVERSE



Series 5
ADJUSTABLE WITH
FREE REVERSE



SIZE	LENGTH	HEX. SIZE
1/4"	2-3/8"	11/16"

SIZE	LENGTH	HEX. SIZE
1/4"	3-3/16"	1-1/8"
3/8"	3-3/4"	1-1/2"
1/2"	4-3/8"	1-5/8"
3/4"	5-9/16"	1-7/8"

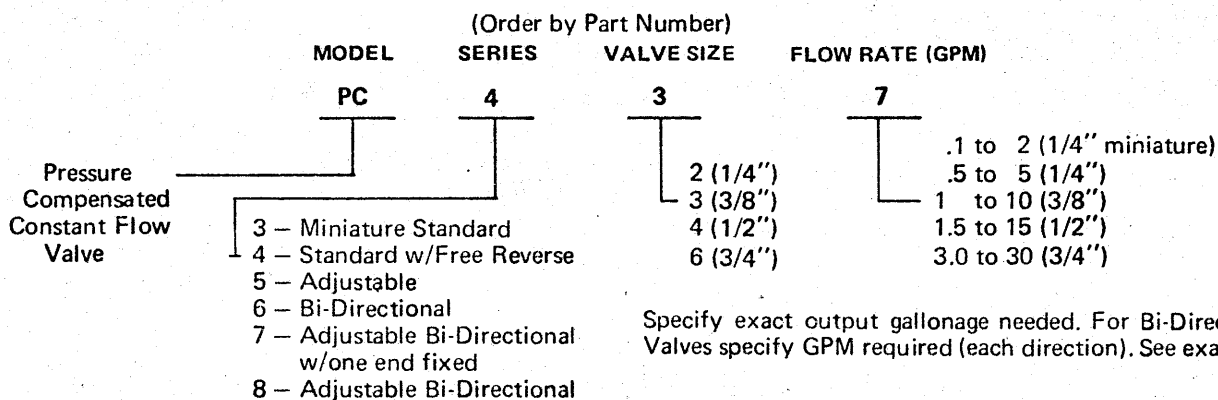
SIZE	LENGTH	HEX. SIZE	HEIGHT OF STEM & KNOB
1/4"	3-3/16"	1-1/8"	57/64" Open 49/64" Closed
3/8"	3-3/4"	1-1/2"	1- 5/32" Open 15/16" Closed
1/2"	4-3/8"	1-5/8"	1-15/32" Open 1- 7/32" Closed

SIZE	Number	GPM Range	Min Oper Pres (ΔP)
1/4"	PC3-2-(GPM)	.1 to 2.0	100

SIZE	Number	GPM Range	Min Oper Pres (ΔP)
1/4"	PC4-2-(GPM)	.5 to 5	100-300
3/8"	PC4-3-(GPM)	1 to 10	100-200
1/2"	PC4-4-(GPM)	1.5 to 15	200
3/4"	PC4-6-(GPM)	3.0 to 30	70

SIZE	Number	GPM Range	Min Oper Pres (ΔP)
1/4"	PC5-2	.75 to 5	100-300
3/8"	PC5-3	1 to 10	100-200
1/2"	PC5-4	1.5 to 15	200

ORDERING INFORMATION



Pneu-Trol Pressure Compensated Constant Flow Valves are exceptionally accurate in maintaining constant flow with pressures up to 3000 psi. Non-adjustable units (Series 4 & 6) provide exact factory-set output gallonage, regardless of inlet pressure up to rated limits. Adjustable valves (Series 5, 7, & 8) permit infinite adjustment of output gallonage independent of inlet pressure, and may be adjusted under pressure. Series 7 valves permit adjustment of output gallonage in one direction, fixed output in the other. Series 8 valves are adjustable in either direction.

Series 3 is a new miniature 1/4" valve for smaller flow rates. Series 4 and 5 Pneu-Trol Pressure Compensated Valves feature free reverse flow, which allows a maximum return flow with minimum pressure drop.

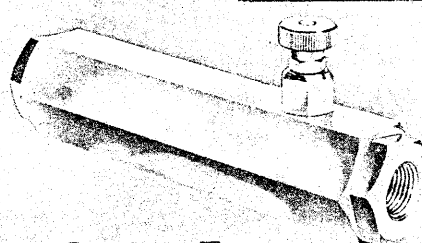
The compensating action of these valves results from a fixed diameter orifice at the intake end

and a series of variable orifices at the output end. Flow through the variable orifices is controlled by a spring and piston. These elements--the spring and piston--work together to regulate hydraulic flow within the determined rates. Flows are controlled within $\pm 15\%$ up to 1.5 GPM and $\pm 10\%$ at higher flow rates up to 30 GPM. Regulation is virtually unaffected by fluid temperature changes from 60° F to 180° F (at a temperature differential $[\Delta T]$ of 70° flow variation is $\pm 2\%$ max; at a temperature differential $[\Delta T]$ of 120° flow variation is $\pm 4\%$ max.)

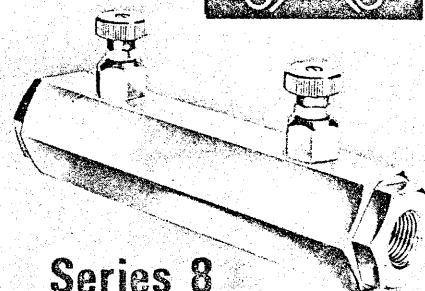
Units are made of high strength, anodized aluminum except 3/4" which is all steel. Ports are tapped with NPTF threads. On special order, these valves can be supplied with ports threaded to AND or MS specification. Ports sizes not listed also may be provided. Consult factory.



Series 6
BI-DIRECTIONAL



Series 7
ADJUSTABLE IN ONE DIRECTION
BI-DIRECTIONAL



Series 8
ADJUSTABLE BI-DIRECTIONAL

SIZE	LENGTH	HEX. SIZE
1/4"	5-1/2"	1-1/8"
3/8"	6-1/2"	1-1/2"
1/2"	7-9/16"	1-5/8"

SIZE	Number	GPM Range	Min Oper Pres. (ΔP)
1/4"	PC6-2-(GPM)	.5 to 5	100-300
3/8"	PC6-3-(GPM)	1 to 10	100-200
1/2"	PC6-4-(GPM)	1.5 to 15	200

SIZE	LENGTH	HEX. SIZE	HEIGHT OF STEM & KNOB
1/4"	5-1/2"	1-1/8"	57/64" Open 49/64" Closed
3/8"	6-1/2"	1-1/2"	1- 5/32" Open 7/32" Closed
1/2"	7-9/16"	1-5/8"	1-15/32" Open 1-15/16" Closed

SIZE	Number (GPM)	GPM Range	Min. Oper Pres. (ΔP)
1/4"	PC7-2	.75 to 5	100-300
3/8"	PC7-3	1 to 10	100-200
1/2"	PC7-4	1.5 to 15	200

SIZE	LENGTH	HEX. SIZE	HEIGHT OF STEM & KNOB
1/4"	5-1/2"	1-1/8"	57/64" Open 49/64" Closed
3/8"	6-1/2"	1-1/2"	1-5/32" Open 15/16" Closed
1/2"	7-9/16"	1-5/8"	1-15/32" Open 1-7/32" Closed

SIZE	Number	GPM Range	Min. Oper (Pres. ΔP)
1/4"	PC8-2	.75 to 5	100-300
3/8"	PC8-3	1 to 10	100-200
1/2"	PC8-4	1.5 to 15	200

EXAMPLE:

Model PC 4-3-7 = Pneu-Trol Fixed Pressure Compensated Standard Valve with free reverse, size 3/8" with flow rate of 7 GPM.

Model PC 5-2 = Pneu-Trol Pressure Compensated Adjustable Valve, with free reverse, size 1/4" with flow rates of .75 to 5 GPM.

Model PC 6-3-5-7 = Pneu-Trol Pressure Compensated Bi-Directional Valve, size 3/8" with flow rates of 5 GPM one direction, 7 GPM opposite direction.

Model PC 7-3-9 = Pneu-Trol Pressure Compensated 3/8" Valve, Adjustable from 1 to 10 GPM one direction, flow rate of 9 GPM opposite direction.



WASHINGTON SCIENTIFIC INDUSTRIES, INC.
POWER COMPONENTS DIVISION

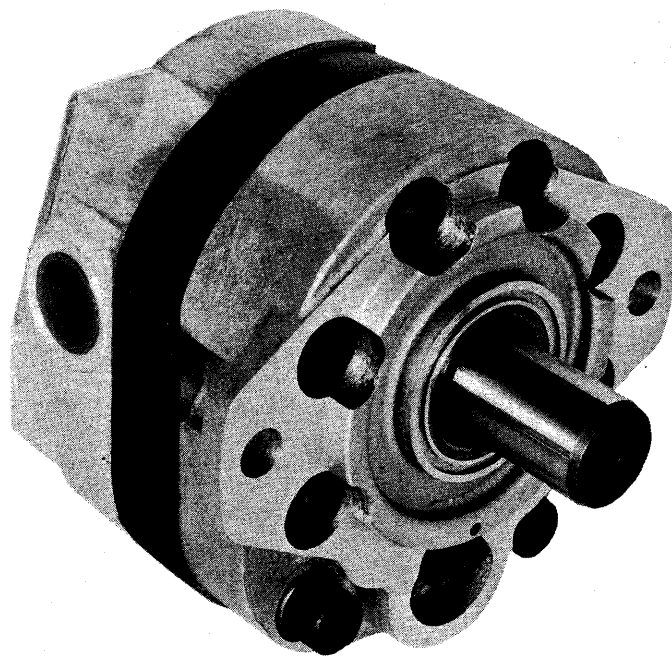
2605 West Wayzata Blvd. PO Box 340
Long Lake, Minnesota 55356
Telephone: (612) 473-1271 TWX: 910-576-2742

ROL-SEAL® MOTOR

ROLLING ABUTMENT TYPE

MODELS RSA,
RSB
AND RSC

MAINTENANCE AND PARTS MANUAL



NOTE

ONLY FACTORY OR QUALIFIED DISTRIBUTORS ARE AUTHORIZED TO OVERHAUL AND REPAIR WSI EQUIPMENT. ALL FACTORY WARRANTY IS CANCELLED UPON DISASSEMBLY BY UNAUTHORIZED PERSONNEL.

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INSTRUCTION MANUAL

INTRODUCTION

The ROL-SEAL[®] Motor was designed to give both high volumetric and high torque efficiencies. It is manufactured with good quality workmanship and a design concept that allows it to be mass produced. Because of its low breakaway and low leakage characteristics it is understandable why this motor is desired in this energy conservation time.

HOW TO AVOID REPAIRS

Maintain cleanliness in your system. Be careful when adding to the reservoir that clean oil is added and the container being used is clean. Proper filtration does not guarantee a contaminate-free system if the filters aren't serviced at regular intervals. Make sure that proper care is taken when installing the motor. If a flexible coupling is used, alignment must be within the coupling range. Do not exceed radial or thrust load ratings of the shaft.

For hydraulic surge pressures applied to or by the motor, a close-coupled direct-acting relief valve must be provided in the circuit. The motor must be protected from any pressure surges that exceed twice the pressure rating of the motor.

DISASSEMBLY

Cleanliness is extremely important when repairing the ROL-SEAL Motor. Before you remove the motor from the system, clean as much debris off of the exterior as possible. The area around the ports is most important. Upon disconnecting use something to plug the ends of the hydraulic lines to prevent contamination of the system.

Remove the key. Carefully remove all burrs from the shaft. Make sure there are no sharp corners around the keyway, to prevent the shaft seal from being cut upon removal of the end cap. If there is any rust present, remove using 180 grit emery cloth.

The tools that are recommended for a successful repair job are as follows:

"A" AND "B" FRAME MOTORS

1. Soft face hammer or mallet.
2. Torque wrench with at least 50 ft. lbs. capacity.
3. $\frac{5}{16}$ " Allen wrench adaptable to torque wrench.
4. No. 03 internal snap ring pliers.
5. $\frac{3}{16}$ " Allen wrench for gear cover.

"C" FRAME MOTOR

1. Soft face hammer or mallet.
2. Torque wrench with at least 175 ft. lb. capacity.
3. $\frac{1}{2}$ " Allen wrench adaptable to torque wrench.
4. No. 06 external snap ring pliers.
5. No. 05 internal snap ring pliers.
6. $\frac{3}{16}$ " Allen wrench for gear cover.

A bench vise is very helpful in the disassembly and assembly of the ROL-SEAL Motor. Our instructions will be based on the assumption that this item is available.

DISASSEMBLY

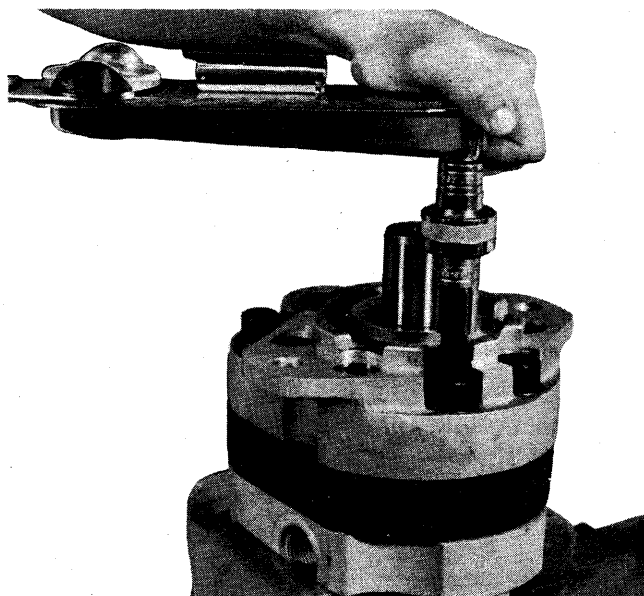


FIGURE 1

1.) Place motor in vise as shown in Fig. 1, tightening vise enough to prevent motor from rocking out. Excessive clamping pressure could damage the inlet and outlet ports. Normally the standard jaws will not contact spot-face of ports.

2.) Unfasten the nine cap screws holding the end caps and housing together. (Fig. 1.) Remove the cap screws completely from the assembly.

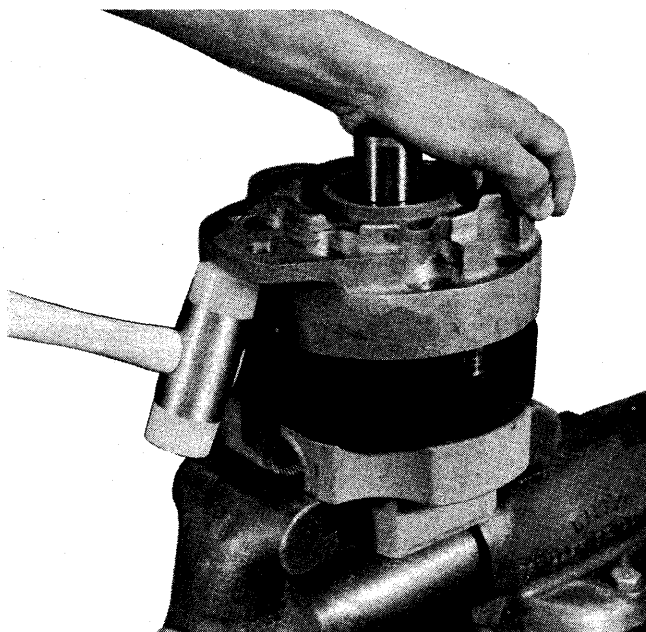


FIGURE 2

3.) Using the soft-faced hammer or mallet, tap upward on the ear of the SAE mounting flange. (Fig. 2.) By putting the heel of your hand over the output shaft and your fingers on the opposite ear you can keep the front end cap from falling back down after each successive rap.

When you get beyond the dowel pin engagement there should be no further requirement for the hammer. Simply lift the end cap off of the assembly.

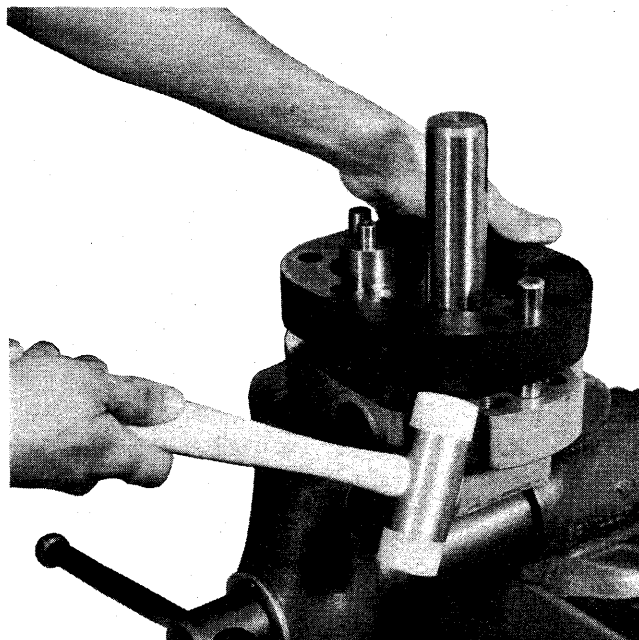


FIGURE 3

4.) Removal of the displacement housing, (Fig. 3) the dark center portion of the assembly, is carried out similar to step 3. There are two scallops in the rear end cap. It is this area that you tap to remove the housing. (Fig. 3.) Do not ever use any screwdriver or pinch bar to remove this part. It is extremely easy to damage the end cap faces. The dowel pins will remain in the displacement housing. Unless you are replacing the housing, leave them intact. The dowels are a press fit.

NOTE

The remaining steps can be performed on a bench.

DISASSEMBLY

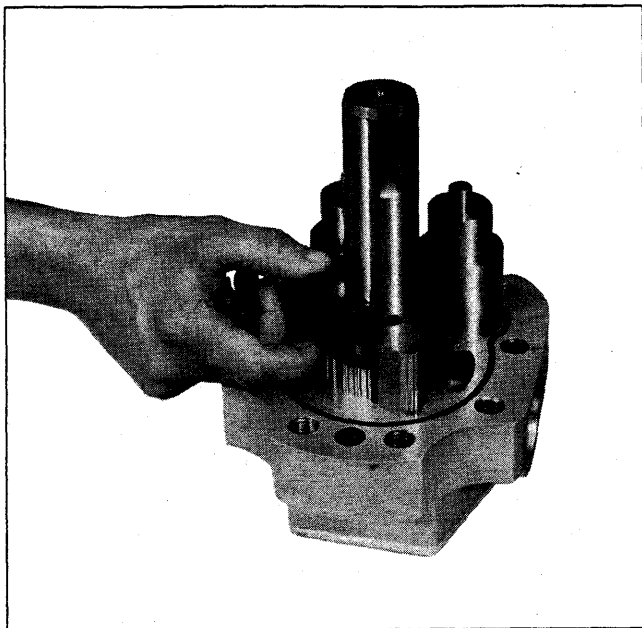


FIGURE 4

5.) Remove seal plates (Fig. 4).

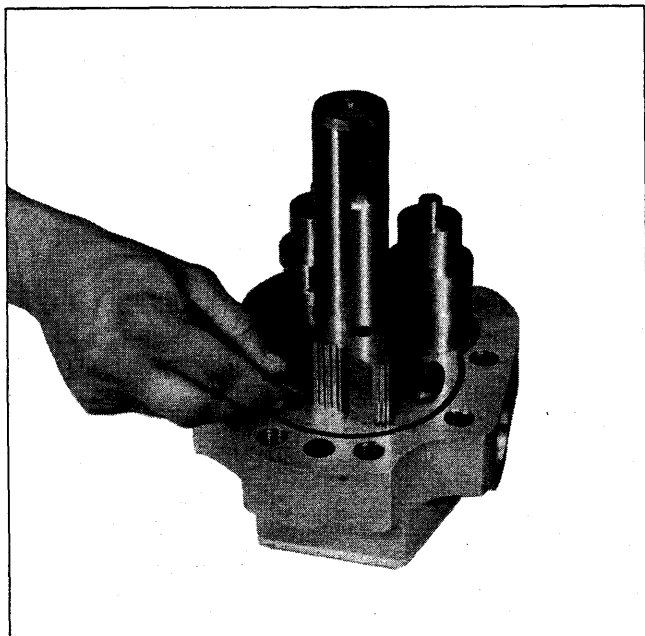


FIGURE 5

6.) Remove seal rollers (Fig. 5). The motors have two sizes. The seal rollers in the rotor tip are about 1/32nd dia. larger than those behind the seal plates.

7.) Unfasten the seven socket head cap screws which hold the Model Code and Serial No. plate on the rear end cap.

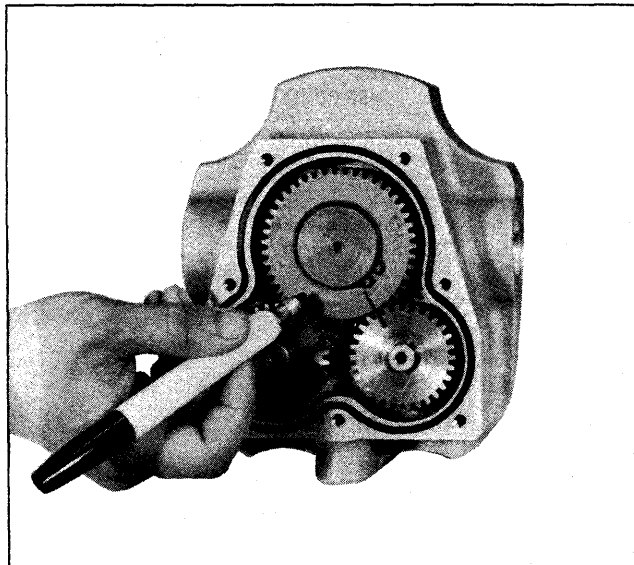


FIGURE 6

8.) The previous step exposed a set of timing gears. Before removing these parts you must mark them (Fig. 6). The two small gears should also be marked left and right.

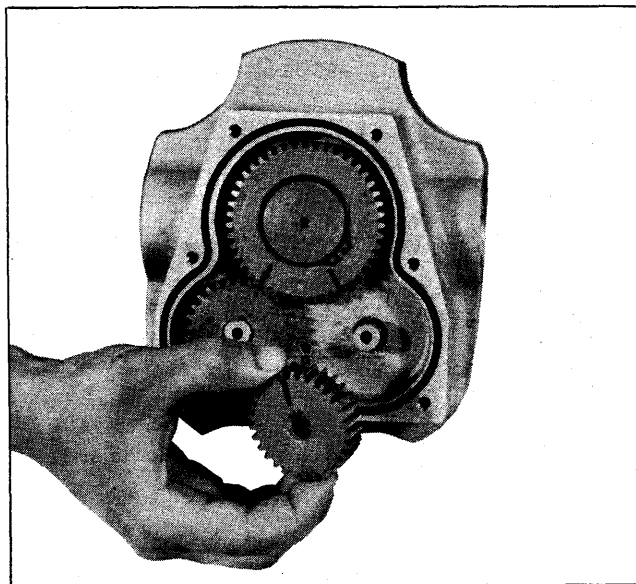


FIGURE 7

9.) Remove the snap rings that retain the gears, (Fig. 7) and remove the gears.

DISASSEMBLY

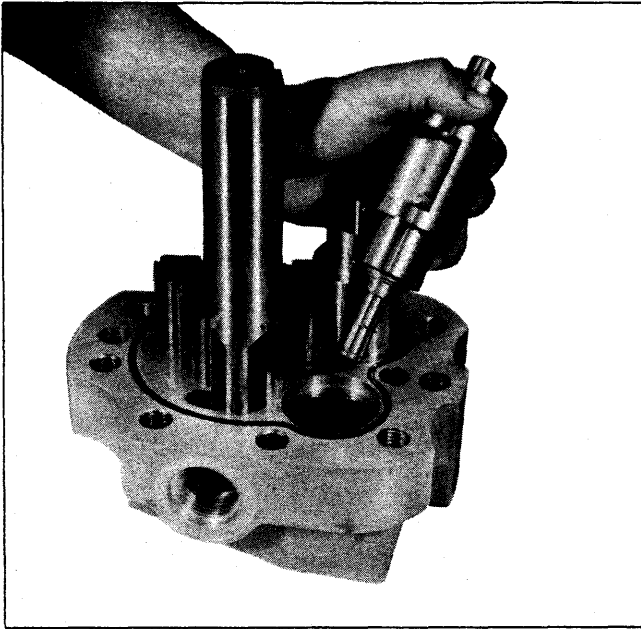


FIGURE 8

10.) By positioning the rotor as in Figure 8, you can lift one of the abutment valves out. Rotate the shaft and remaining abutment until the paddle of the rotor leaves the abutment cavity. You now can remove this abutment.

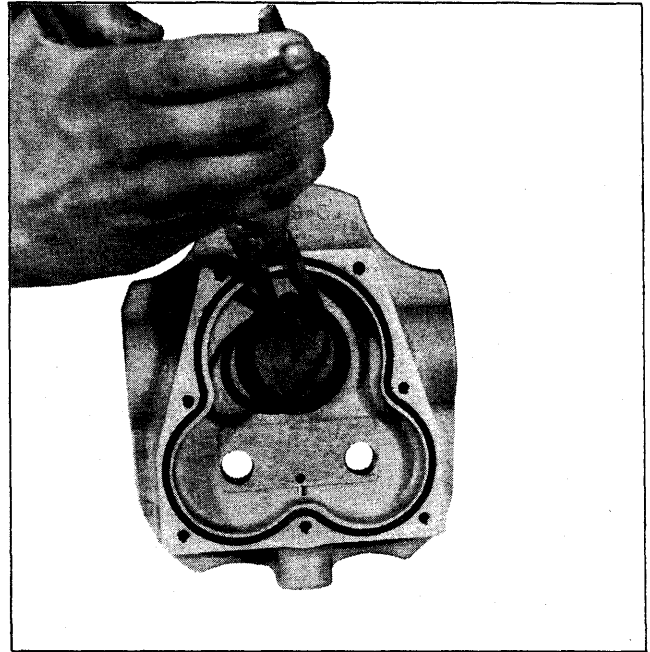


FIGURE 10

12.) Remove the snap ring which retains the shaft and thrust bearing. (Fig. 10.)

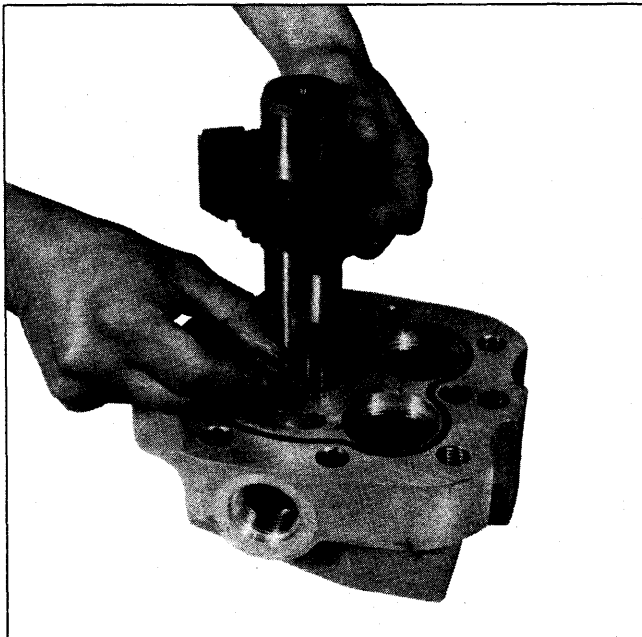


FIGURE 9

11.) Lift the rotor up, which will expose the drive key. Remove the drive key. (Fig. 9.)

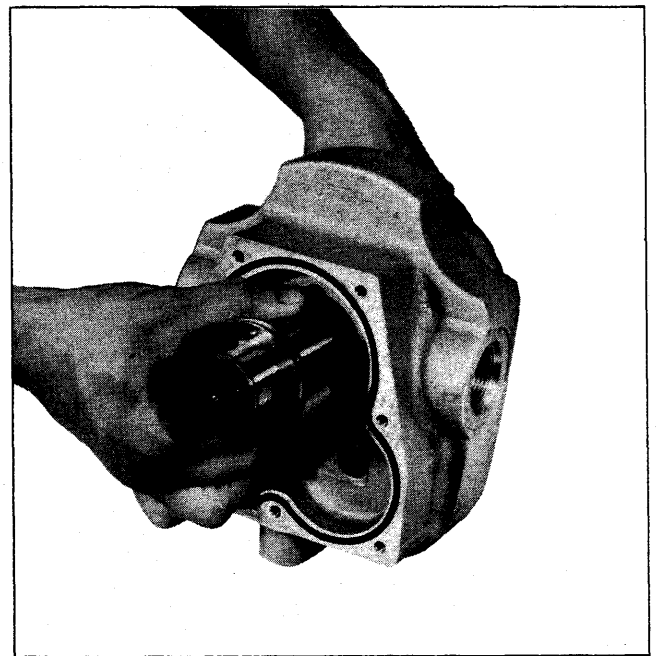


FIGURE 11

13.) Remove the shaft from the rear end cap. (Fig. 11.)

DISASSEMBLY

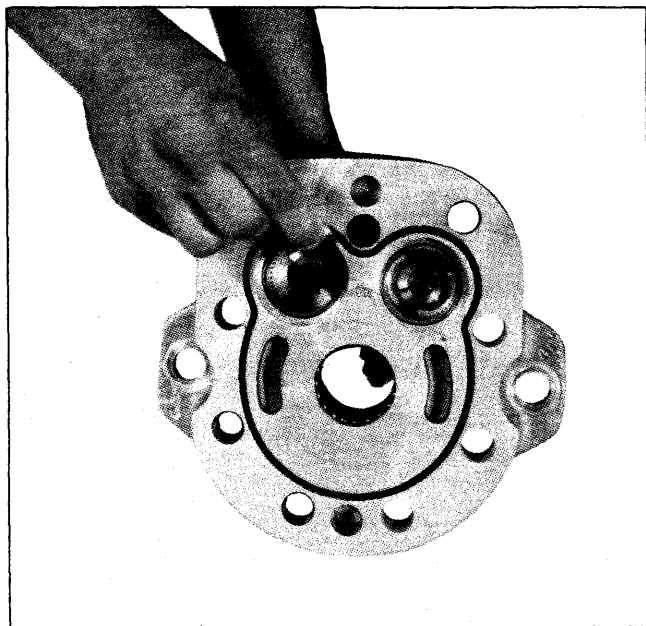


FIGURE 12

14.) The step bearing that remains in the front end cap should be taken out and inspected. There is an O-ring and Teflon back-up ring under this part. (Fig. 12.)

15.) Check all mating metal-to-metal parts for scratches or burrs which could cause leakage. Replace all parts on which excessive damage is found. Use the following procedure to be sure that all these surfaces are perfectly smooth:

Place a piece of 240 grit paper on a flat, smooth surface.

Place the part on the grit paper and stroke gently in a figure eight motion several times. Excessive removal of material should not be done as the parts may not reassemble with proper clearances.

16.) Clean all parts in solvent and let them air-dry. All O-rings and shaft seals should be replaced. If conditions are such that you have to use the old seals they should be washed in a mild soap and water solution.

REASSEMBLY

1.) Install shaft with thrust bearing and races through the back of the rear end cap.

2.) Install snap ring to retain shaft.

3.) Put spacer over shaft end, and assemble the large timing gear to the shaft.

4.) Assemble snap ring to retain gear.

5.) Turning this subassembly and setting it on the rear cover face, you can install one abutment valve. Install new back-up ring and O-ring first. A light film of oil should be applied to all new seals.

6.) Reassemble the round drive key in the key seat and slip rotor over key.

7.) Set the subassembly on its side and proceed with the alignment and timing of the abutment and rotor. Either one of the abutments can be assembled.

8.) Rotate the shaft so the second abutment can be installed. Align the timing marks. If the shaft can be rotated one complete revolution, it is likely that the proper assembly has been carried out. NOTE: When properly timed, the rotor tip will pass directly through the center of the abutment cavity.

9.) Proceed to assemble the snap rings to retain the gears assembled in the previous step.

10.) Set the assembly back on the rear cover face. Install the seal plates and the seal pins in the rotor.

11.) Place the new O-ring in the groove of the end cap. A light film of gun grease will help keep the O-ring from slipping out of the groove.

12.) Install the housing. If binding occurs take a soft faced hammer and tap on the housing to free it.

13.) Install new O-rings and back-up rings in the front end cap. Put the step bearings in place. Apply a light film of gun grease to the large static seal, and place it in the groove.

14.) Install the front end cap by slipping it over the shaft and watching the static seal to make sure it stays in place. Tapping lightly with a soft face hammer may be required to seat the front end cap.

15.) Set the body cap screws in place and tighten to recommended torque values using a crisscross pattern. Torque settings are for lubricated threads. (see chart on following page)

REASSEMBLY

FRAME SIZE	DISPLACEMENT	TORQUE
"A" and "B"	2	500 in # (56 N-M)
"A" and "B"	3	500 in # (56 N-M)
"A" and "B"	4	500 in # (56 N-M)
"C"	6	150 ft # (203 N-M)
"C"	8	150 ft # (203 N-M)
"C"	10	175 ft # (237 N-M)
SERIAL COVER PLATE	ALL	125 in # (14 N-M)

16.) Assemble Model Code and Serial No. plate to back of the motor along with new static seal.

17.) Before installing new shaft seal, make sure that shaft turns. Then proceed to install new seal and replace snap ring.
NOTE: Remove any burrs or raised edges from shaft keyway as not to damage seal lip.

18.) Replace motor in the system and run unit through normal operating cycle.

SEAL REPLACEMENT

1.) Clamp the motor in a vise. Remove the key and all burrs or sharp edges which may have developed. Use 400 grit emery cloth to remove all rust from the shaft.

2.) Remove the snap ring.

3.) Remove front end cap as in steps 1-3 of the disassembly procedure.

4.) Turn end cap with sealing face up. Use a large screwdriver blade inserted between the seal lip and shell. Proceed to pound out seal alternating from side to side so as not to damage the end cap bore.

5.) Replace end cap and torque body bolts to recommended torque, (see chart above.)

6.) Apply a thin film of grease to the lip of the new seal. Slide over shaft to face of end cap.

7.) The seal must be installed without cocking it. The best procedure is to obtain a short piece of tubing or pipe which is square on the ends and will contact the outer shell of the seal. If the tubing is too small it will damage the seal.

8.) Press seal in just far enough so the snap ring will stay in the seal bore. Using the snap ring to seat the seal will prevent you from pressing the seal in too deep. When the snap ring pops into the groove the seal is properly seated.

TROUBLE SHOOTING

The following chart lists the possible troubles that may be encountered, the probable cause and the remedial action recommended.

TROUBLE-SHOOTING CHART		
Trouble	Probable Cause	Remedy
No pressure	1.) Loose coupling. 2.) System relief open.	1.) Repair or replace coupling. 2.) Clean, adjust, or replace if necessary.
Noisy system	1.) Cavitation at pump. 2.) Reservoir low.	1.) Check for inlet air leaks. Check pump inlet for restriction. 2.) Fill to recommended level.
Motor will not develop torque.	1.) System relief unloading. 2.) Worn out. 3.) High temperature operation.	1.) Disassemble, clean, adjust. 2.) Repair or replace. 3.) Change to fluid with higher viscosity index.
Blown rear cover	1.) Drain restriction. 2.) High case drain.	1.) Drain directly to tank. 2.) Repair motor.
Leakage around shaft.	1.) Shaft seal worn out.	1.) Replace.
Motor turns in wrong direction.	1.) Hose connection wrong.	1.) Reverse connections.

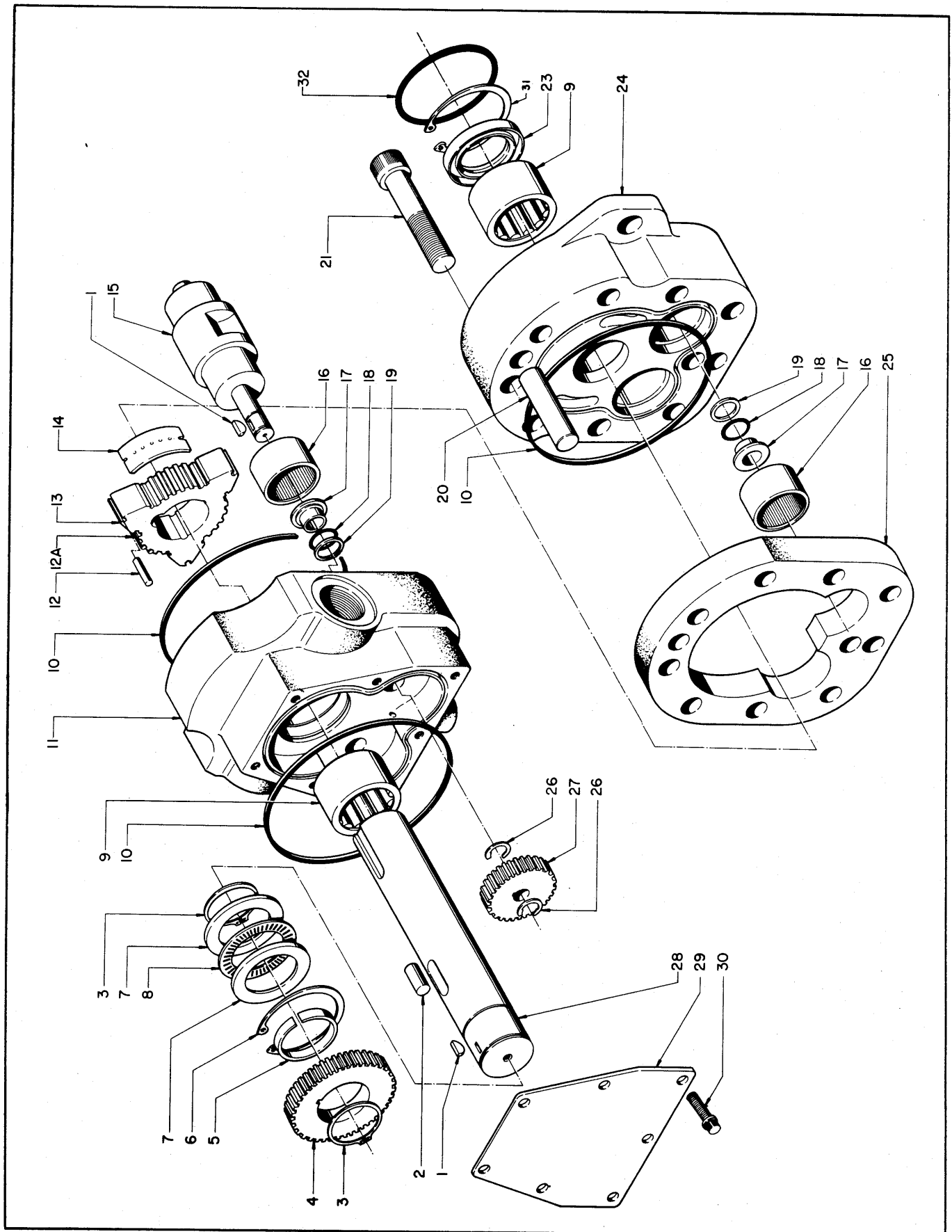


FIGURE 13. ROL-SEAL MOTOR EXPLODED VIEW

PARTS LIST

REPLACEMENT PARTS LIST - ROL-SEAL® MOTOR

NOTE

When Ordering Replacement Parts, Give Model Number, Serial Number, Item Number, Description and Quantity.

Item	Description	Quantity
1	Key, Woodruff	3
2	Pin, Drive	1
3	Ring, Retaining	2
4	Gear, Drive	1
5	Spacer	1
6	Ring, Retaining	1
7	Race, Bearing Thrust	2
8	Bearing, Thrust	1
9	Bearing, Roller	2
10	Seal, O-Ring	3
11	Cap, Rear	1
12	Pin, Rotor Tip	3
12A	Pin, Seal Plate	18
13	Rotor	1
14	Plate, Seal	3
15	Valve, Rotary Abutment	2
16	Bearing, Needle	4
17	Bearing, Step	4
18	Seal, O-Ring	4
19	Ring, Teflon Backup	4
20	Pin, Dowel	2
21	Screw, Cap	9
23	Seal, Shaft	1
24	Cap, Front	1
25	Housing, Displacement	1
26	Ring, Retaining	4
27	Gear, Timing	2
28	Shaft, Power	1
29	Cover, Gear	1
30	Screw, Cap	7
31	Ring, Retaining	1
32	O-Ring, Front Cap Seal	1



WASHINGTON SCIENTIFIC INDUSTRIES, INC.
POWER COMPONENTS DIVISION

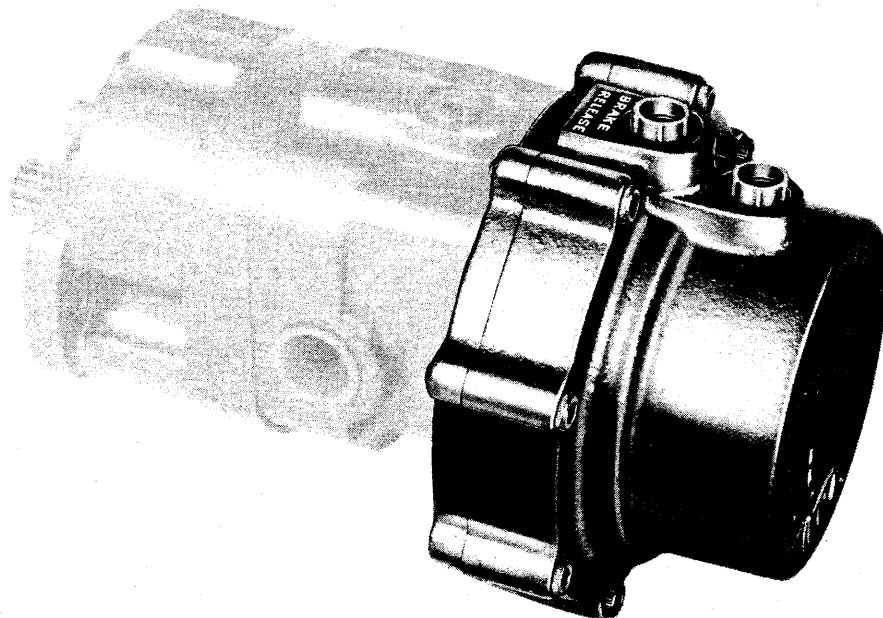
Long Lake, Minnesota 55356

Telephone: (612) 473-1271 TWX: 910-576-2742

ROL-SEAL® BRAKE

REAR-MOUNTED, MULTI-DISC
TYPE FOR RSA AND
RSC MOTORS

MAINTENANCE AND PARTS MANUAL



NOTE

ONLY FACTORY OR QUALIFIED DISTRIBUTORS ARE AUTHORIZED TO
OVERHAUL AND REPAIR WSI EQUIPMENT. ALL FACTORY WARRANTY IS
CANCELLED UPON DISASSEMBLY BY UNAUTHORIZED PERSONNEL.

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INSTRUCTION MANUAL

INTRODUCTION

This Wet Disc Type Brake was designed to fit on the W.S.I. Rol-Seal® Motor to provide either dynamic braking, or as a mechanical means of locking the motor shaft to prevent motor drift due to overhanging loads. The number of disc brake sets provide for a higher static torque loading than the dynamic torque rating of the hydraulic motor.

HOW TO AVOID REPAIRS

Maintain cleanliness in your hydraulic system. Be careful when adding to the reservoir that clean oil is added and the container being used is clean. Proper filtration does not guarantee a contaminate-free system if the filters aren't serviced at regular intervals. Caution should be used when connecting the brake release pressure port to the brake housing inasmuch as the drain port is adjacent to the pressure port.

CASE DRAIN

These units are provided with a case drain connection. A line must be provided to return case drain flow to the reservoir at no more than 250 PSI surge pressure. Cross port check valves are optional for internal drain but should not be used where instantaneous shock pressures occur, such as in dynamic braking.

OTHER BRAKE SPECIFICATIONS

WK ² of brake	2.6 lb. in. ²
Volume of oil to release brake	0.6 in. ³
Torque holding capacity	2 in. ³ 3 in. ³ 4 in. ³
	940 lb. in. 1410 lb. in. 1880 lb. in.

DISASSEMBLY

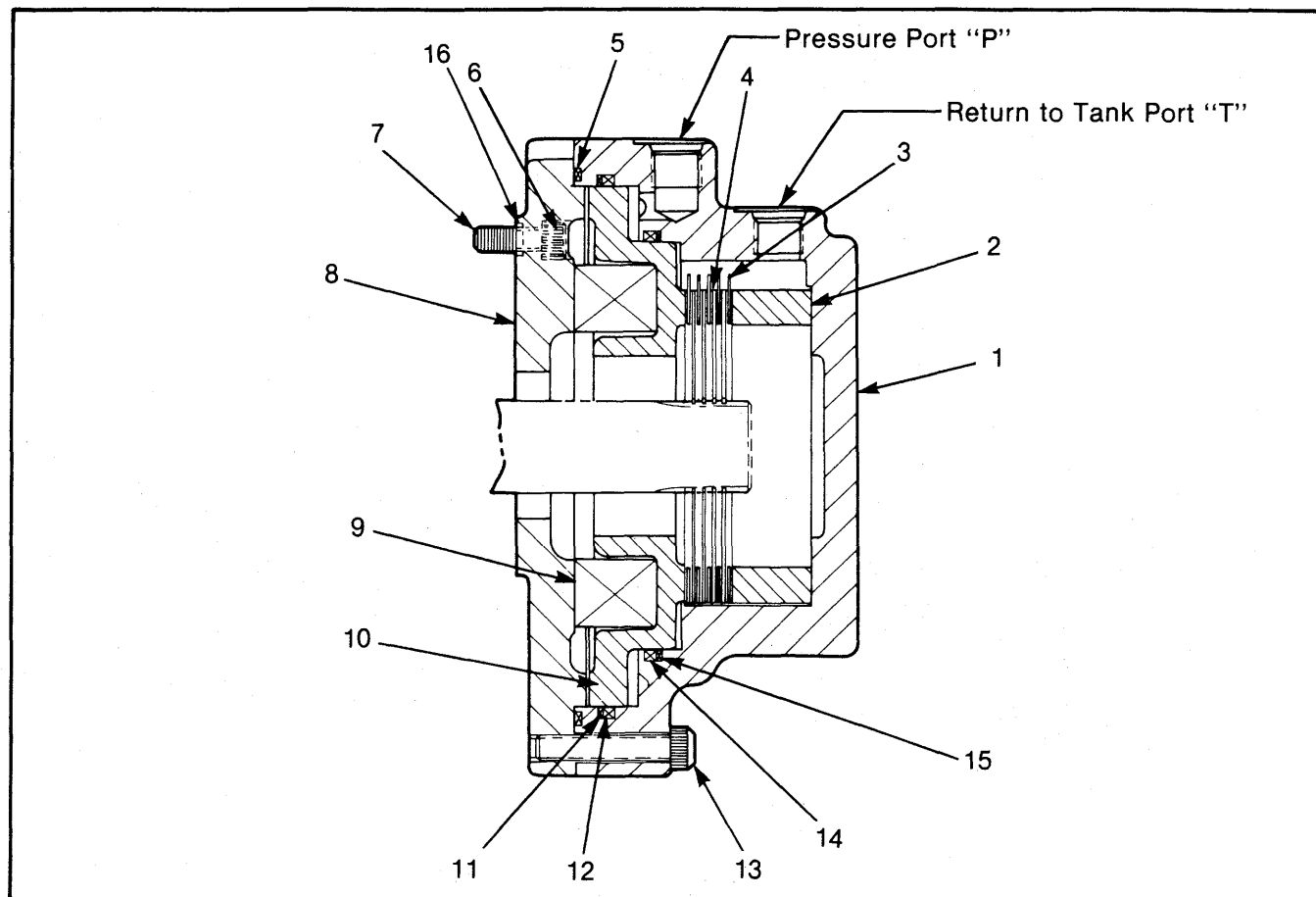


FIGURE 1. SECTIONAL VIEW, ROL-SEAL® BRAKE

REAR MOUNTED BRAKE ASSEMBLY

TOOLS REQUIRED: ¼ allen wrench

NOTE: If it is necessary to remove adapter plate (8), a ⅜ allen wrench and centering fixture (available from factory) will be required.

DISASSEMBLY (Figure 1)

1. Thoroughly clean the exterior of the assembly and hydraulic lines before attempting removal.
2. Disconnect hydraulic lines and cap them to prevent loss and contamination of fluid.
3. Remove the eight cap screws (13), and separate the brake housing (1) from the adapter plate (8). Discard O-ring (5).
4. Remove remaining brake components.
(To remove brake piston (10), it may be necessary to inject shop air (80 PSI max.) into pressure port "P". PLEASE NOTE: If air is used, precautions must be taken to retain piston so as to eliminate the possibility of injury!)
5. Remove the back-up rings (11, 15), and O-rings (12, 14) from the housing (1).
6. If it's necessary to remove the adapter plate (8) from the motor, remove the seven cap screws (7).
7. Clean all components in solvent and dry.
8. Inspect all components for wear and damage. Replace components unfit for service. Note quantities of friction discs (3) and drive plates (4) in parts lists on following pages.

REASSEMBLY

(See Figure 2)

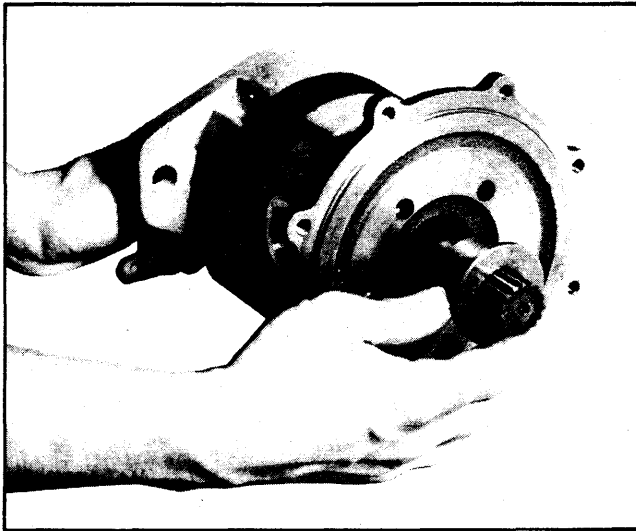


FIGURE 2. CENTERING FIXTURE

1. If adapter plate (8) is removed, reassemble on the motor using a centering fixture available from factory. Install capscrews (7) with washers (6) including O-rings (16) for RSC brake and torque to 150 in. lb.
2. Install new O-rings (12, 14) and back-up rings (11, 15) in the housing (1). Make sure the ends of the back-up rings are flush and not overlapped.

NOTE: Backup rings (11, 15) must be in position as shown in sectional view.

3. Lubricate all components with clean hydraulic fluid.

4. Position the spacer rings (2) in the housing (1).

NOTE: Spacer ring thickness varies with motor size. See parts list.

5. Locate friction disc (3) in the housing; then a driver plate (4); then another friction disc (3); and so on depending on model, making sure driver plate splines are aligned.

6. Carefully install the pressure plate (10) in the housing so as not to damage the O-rings (12, 14). Place the eight die springs (9) in the pressure plate.

7. Position a new O-ring (5) in the housing using a little grease to hold it in place.

8. To assemble motor to brake, carefully drop shaft while engaging the plate drivers (4) with the splined motor shaft.

9. Secure the housing to the adapter plate with the eight cap screws (13). Tighten and torque the cap screws to 300 in. lbs.

10. Connect the hydraulic lines.

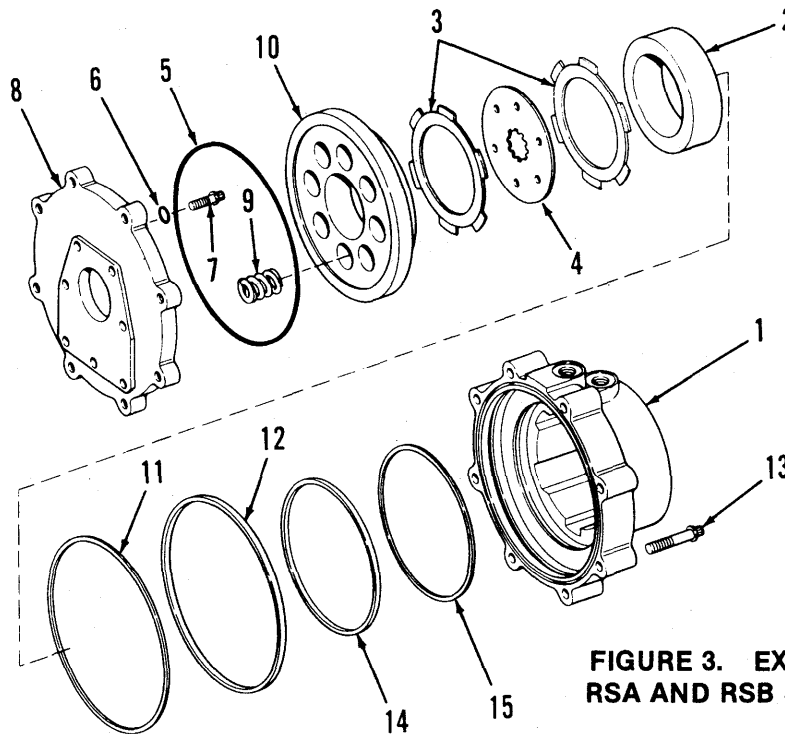
11. Test the brake for operation and leaks.

PARTS LIST

REPLACEMENT PARTS LIST—REAR MOUNTED BRAKE ASSEMBLY MODELS RSA02, RSA03, RSA04, RSB02, RSB03, RSB04, BRAKE

NOTE

When ordering replacement parts, give model number, serial number, item number, part number, description and quantity.



**FIGURE 3. EXPLODED VIEW
RSA AND RSB SERIES BRAKE**

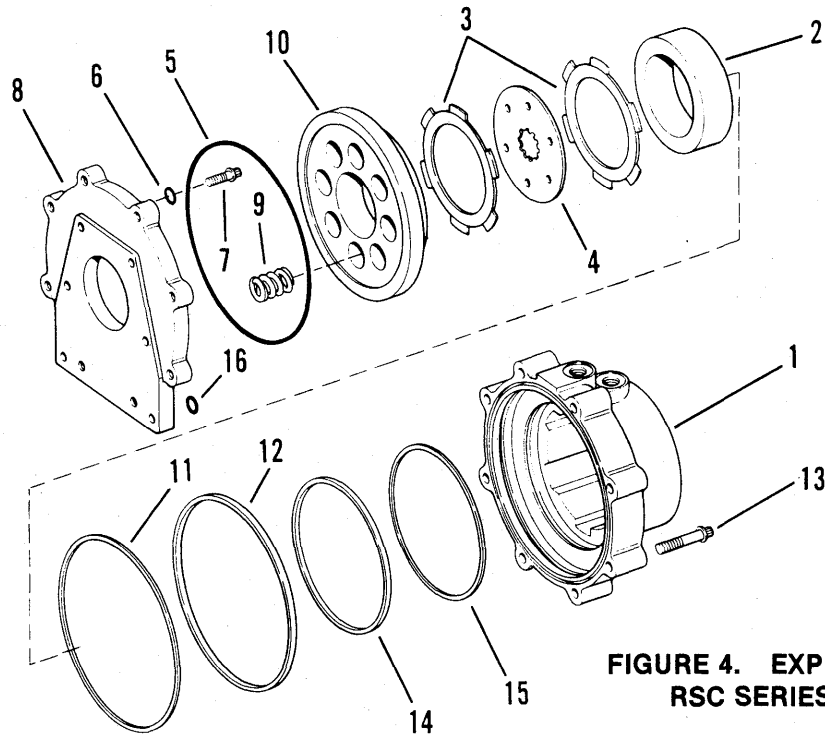
Item	Part No.	Description	Quantity
1	C-63086	Housing	1
2	A-63095	Spacer Ring 2 Cubic Inch	1
2	A-63096	Spacer Ring 3 Cubic Inch	1
2	A-63120	Spacer Ring 4 Cubic Inch	1
3	B-62308	Friction Disc 2 Cubic Inch	3
		3 Cubic Inch	4
		4 Cubic Inch	5
4	B-63100	Plate Driver 2 Cubic Inch	2
		3 Cubic Inch	3
		4 Cubic Inch	4
5	A-63097	O-Ring	1
6	A-60709	Brass Washer	7
7	A-60955	Cap Screw—Socket Head	7
8	C-63087	Adapter Plate	1
9	A-62298	Die Spring	8
10	B-63093	Pressure Plate	1
11	B-62303	Back-Up Ring	1
12	B-62301	O-Ring	1
13	A-61716	Cap Screw—Socket Head	8
14	B-62302	O-Ring	1
15	B-62304	Back-Up Ring	1

PARTS LIST

REPLACEMENT PARTS LIST RSC MODEL ROL-SEAL® BRAKE

NOTE

When ordering replacement parts, give model number, serial number, item number, part number, description and quantity.

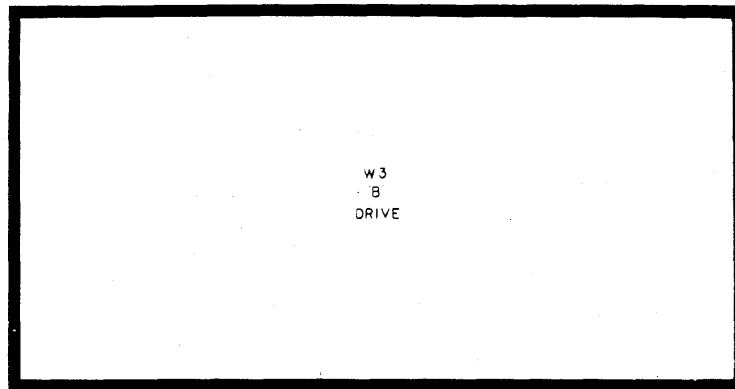


**FIGURE 4. EXPLODED VIEW
RSC SERIES BRAKE**

Item	Part No.	Description	Quantity
1	C-63086	Housing	1
2	A-63118	Spacer Ring 6 Cubic Inch	1
2	A-63119	Spacer Ring 8 Cubic Inch	1
2	A-63079	Spacer Ring 10 Cubic Inch	1
3	B-62308	Friction Disc 6 Cubic Inch	7
		8 Cubic Inch	9
		10 Cubic Inch	12
4	B-63099	Driver Plate 6 Cubic Inch	6
		8 Cubic Inch	8
		10 Cubic Inch	11
5	A-63097	O-Ring	1
6	A-60709	Brass Washer	6
7	A-60500	Cap Screw—Socket Head	6
8	C-63089	Adapter Plate	1
9	A-62298	Die Spring	8
10	B-63093	Pressure Plate	1
11	B-62303	Back-Up Ring	1
12	B-62301	O-Ring	1
13	A-61716	Cap Screw—Socket Head	8
14	B-62302	O-Ring	1
15	B-62304	Back-Up Ring	1
16	A-60846	O-Ring	2

Torque-Hub® Final Drives

Service Manual



Fairfield Manufacturing Company, Inc.

South Concord Road, Lafayette, Indiana 47902, U.S.A. 317/474-3474

Fairfield

THE
DRIVE
PEOPLE

Introduction


This Service Manual is a step-by-step guide designed for the customer or shop mechanic who is servicing or repairing a particular model of Torque-Hub Final Drive. (The model covered by this copy of the Manual is specified on the Manual cover.)

Included are —

1. assembly and exploded view drawings
2. disassembly procedure
3. main assembly procedure (assuming all sub-assemblies to be intact)
4. sub-assembly procedures.

At the time of printing, this Manual was complete for the specific Torque-Hub model designated. However, Fairfield Manufacturing Co., Inc., reserves the right to update and improve its products at any time. All specifications and procedures are therefore subject to change without notice.

Safety

Standard safety practices should be followed during the disassembly and assembly procedures described. Safety glasses and safety shoes should be worn; heavy, heat resistant gloves should be used when heated components are handled. Be especially alert when you see a caution symbol () . This symbol indicates that a particular operation could cause personal injury if not performed properly or if certain safety procedures are not followed.

W3B-W3C

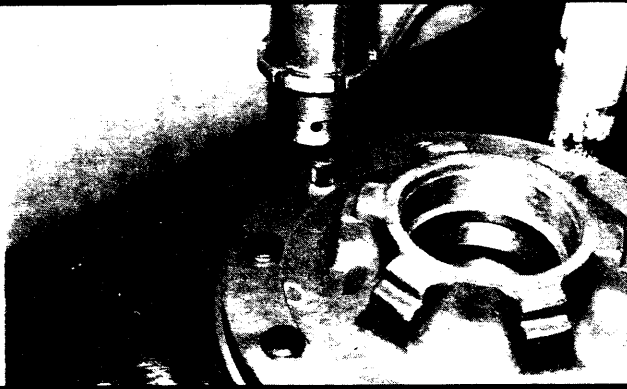
Disassembly Procedure

1. Loosen all 12 Cover Bolts and drain the oil from the unit.
2. Remove the 12 Cover Bolts and lift off the Cover Sub-Assembly. Discard the 'O' ring Seal from the Cover counterbore.
3. Lift out the Carrier Sub-Assembly and *Thrust Bearing Set. A Thrust Washer may stick inside the Cover.
4. Pry the Ring Gear loose and remove it. Discard the 'O' ring Seal from the Hub counterbore.
5. Remove the Input Shaft, Input Gear, and the Thrust Spacers that are on the Input Shaft.
6. Lift out the Internal Gear and Thrust *Bearing Set. A Thrust Washer may stick to the bottom of the Carrier.
7. Remove the Retaining Ring from the Spindle and discard; then lift the hub off the Spindle.
Eye protection should be worn during Retaining Ring removal.
8. The inside Bearing Cone and the Bearing Shim can now be removed.
9. The Seal can be pried out of the Hub with a screw driver or pry bar. This will also allow the outside Bearing to be removed.
10. To remove the Cluster Gears from the Carrier, drive the anti-roll pin into the Planet Shaft of the Cluster Gear. After the Planet Shaft is removed the roll pin should be driven out of the Planet Shaft.

WARNING: When rebuilding the unit, the 'O' rings and Retaining Rings should always be replaced.

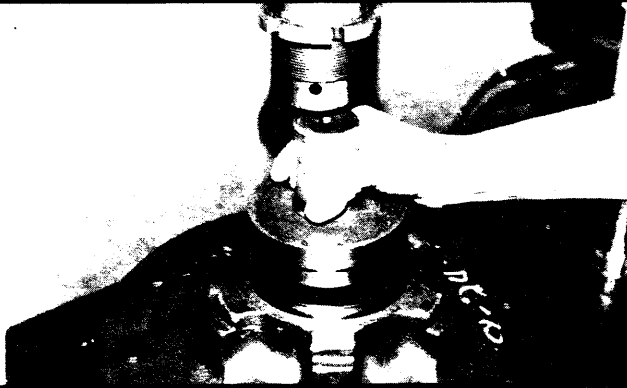
Note: If bearing replacement is necessary, the Bearing Cups can be removed with a "slide hammer puller" or driven out with a punch.

Main Assembly Procedure

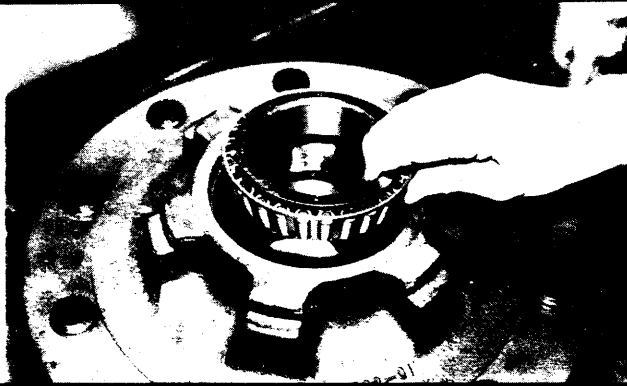


1. Using an arbor type press if available, (if not, a hammer may be used), install the wheel studs. The hub flange should be supported from the underside during this operation.

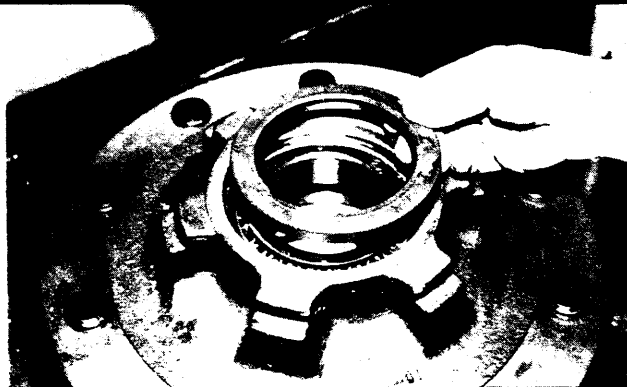
Note: Wheel studs are optional.



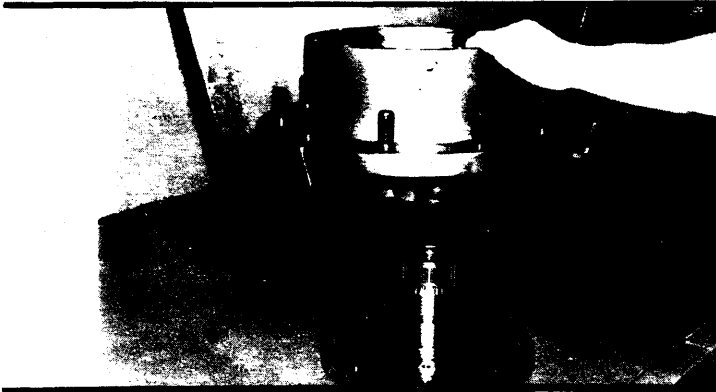
2. Using an arbor type press if available, press Bearing Cups with large inside diameters facing out, into Hub counter-bores. Cup #JM716610 will go into small end of Hub, and Cup #JM515610 will go into large end of Hub.



3. Place Bearing cone #JM716649 into Bearing Cup in small end of Hub.



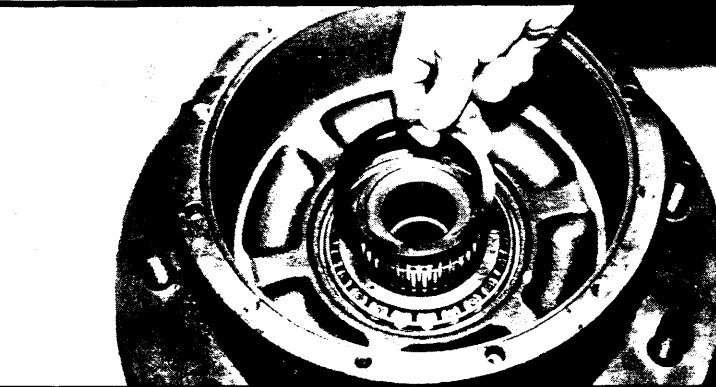
4. Press Seal into Hub counterbore with flat metal side facing in. Use a flat object to assure that Seal is pressed evenly and is flush with Hub face.



5. Lower Hub onto Spindle with large open end up.



6. Place Bearing cone #JM515649 over end of Spindle and into Bearing Cone.

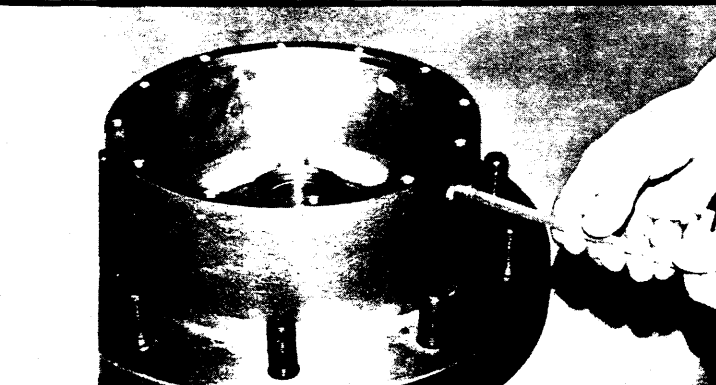


7. Place Bearing Shim over end of Spindle and against Bearing Cone.

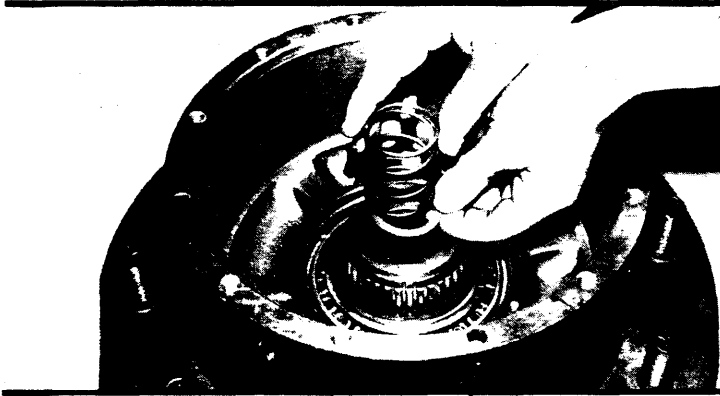


8. Secure Retaining Ring completely into Spindle groove and against Bearing Shim. Be sure that Retaining Ring is entirely in groove.

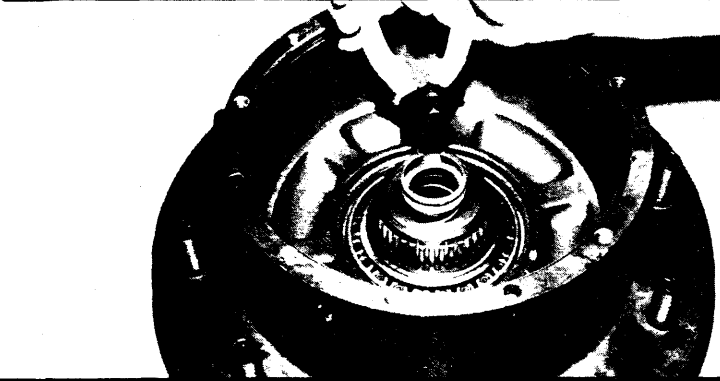
⚠ Eye protection should be worn during Retaining Ring installation.



9. The pipe plugs are installed in the Hub. The use of lub-seal is recommended on the pipe plug.

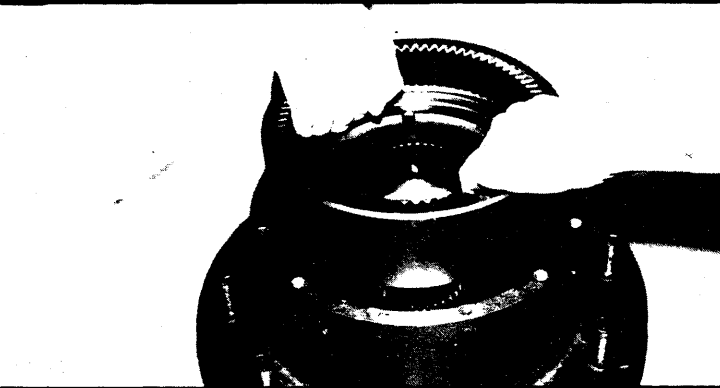


10. The disengage spacer and spring are installed into the co'bore of the Spindle.

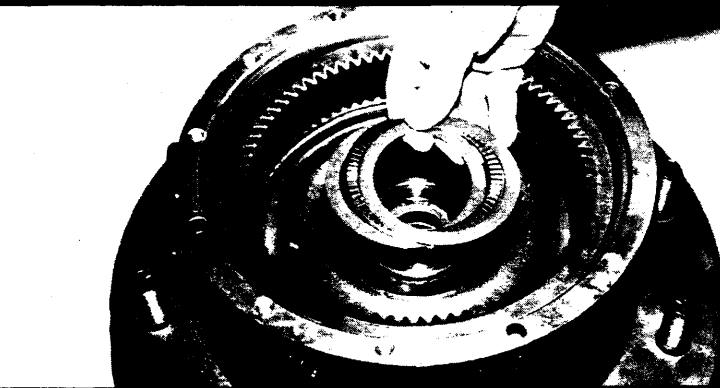


11. Another spacer and the correct Retaining Ring are installed into the Spindle co'bore and Retaining Ring groove provided.

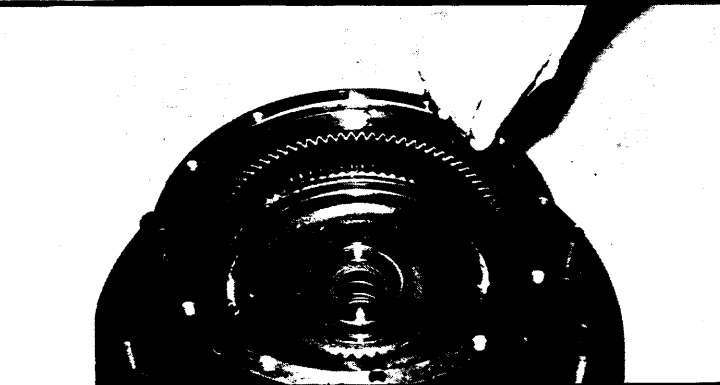
⚠ Eye protection should be worn during Retaining Ring installation.



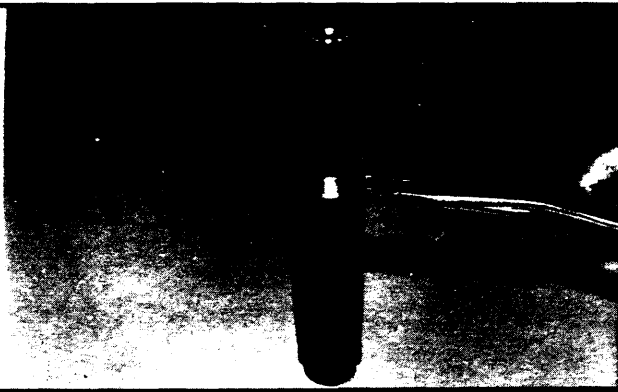
12. The internal gear is installed matching the Bore Spline to the Spindle Spline.



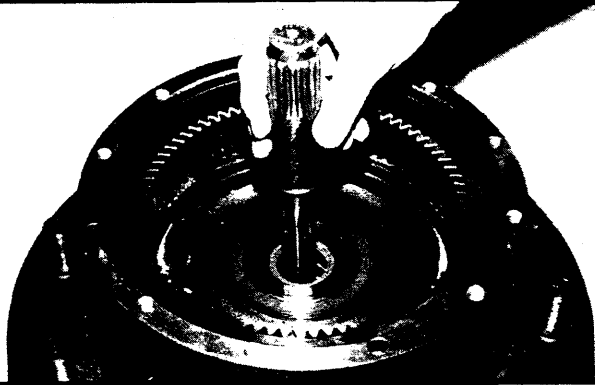
13. The thrust washer/thrust bearing set is installed on the portion of the Spindle which extends into the internal gear.



14. The O'Ring is placed into the counterbore provided in the Hub. Slight stretching may be necessary. Use sufficient grease or petroleum jelly to hold in place.

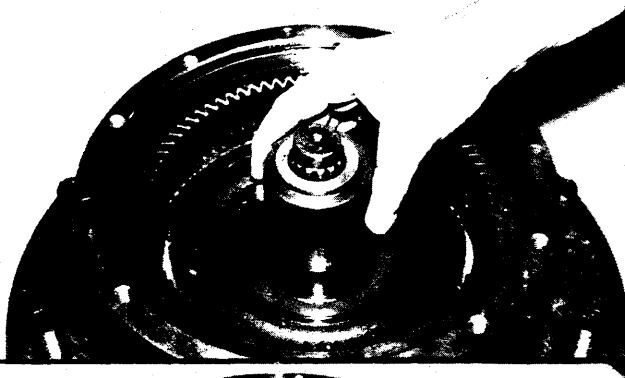


15. Install retaining ring into input shaft retaining ring groove.

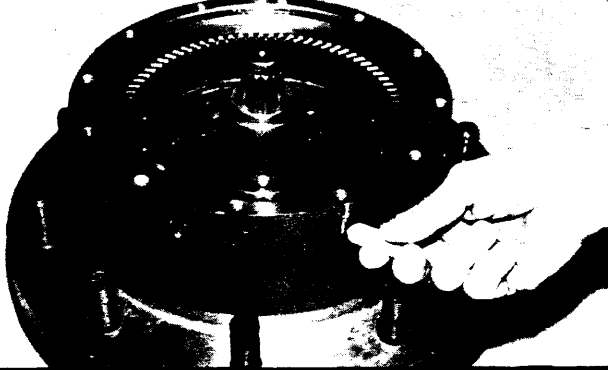


16. The input shaft is installed into the spindle.

The action of the spring should be checked at this point.

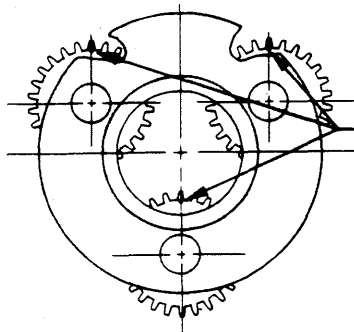


17. The thrust spacer is installed on the input shaft.



18. Locating the four counter reamed holes in the face of the hub, mark them for later identification.

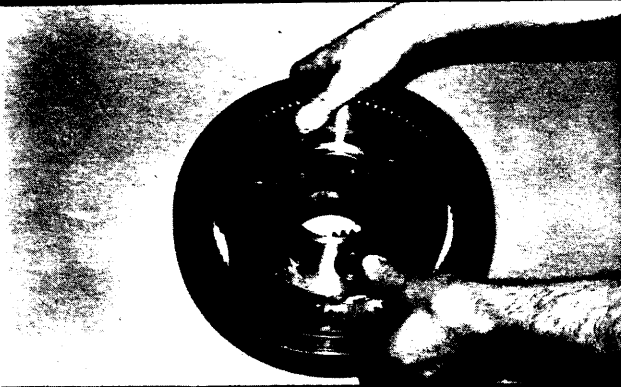
These holes are reamed to accept the shoulder bolts.



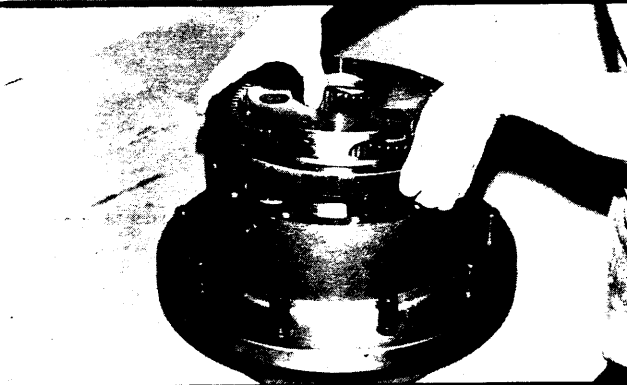
position
punchmarks
at 12 o'clock



19. Place Carrier Assembly on a flat surface with the large gears up and positioned as shown. Find the punch marked tooth on each large gear and locate at 12 o'clock (straight-up) from each planet pin. Marked tooth will be located just under the Carrier on upper two gears.

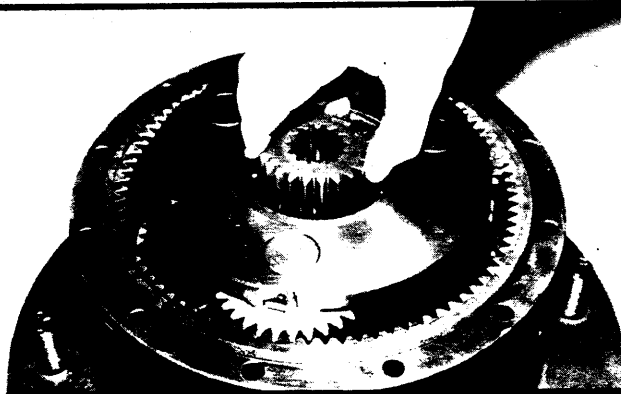


20. With shoulder side of Ring Gear facing down, place Ring Gear over (into mesh with) large gears. Be sure that punch marks remain in correct location during Ring Gear installation. The side of the Ring Gear with an "X" stamped on it should be up.



21. While holding Ring Gear and Cluster Gears in mesh, place small side of Cluster Gears into mesh with the Internal Gear. On the Ring Gear locate the hole marked "X" over one of the marked counterbored holes in Hub.

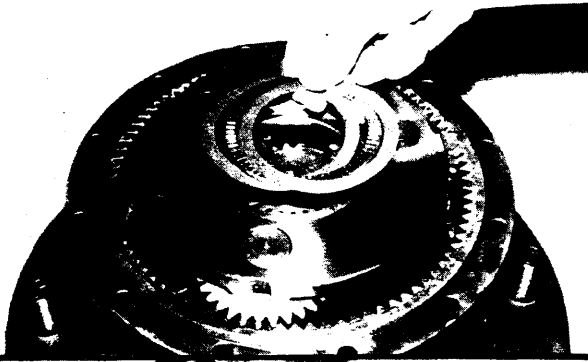
Note: If gears do not mesh easily or Carrier Assembly does not rotate freely, then remove the Carrier and Ring Gear and check the Cluster Gear timing.



22. The Input Gear is installed into this assembly meshing with the larger diameter Cluster Gear. The counterbored side of the Input Gear is installed down or to the inside of the unit.



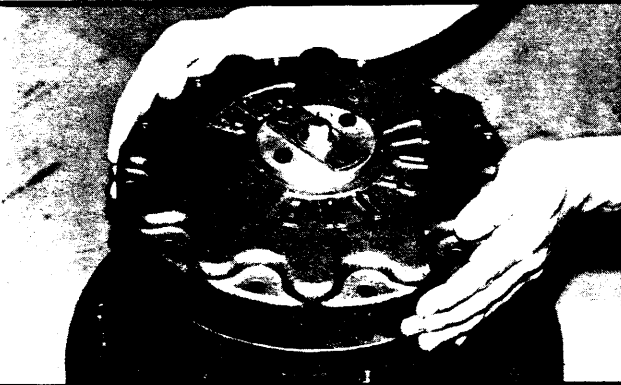
23. After inserting at least one Shoulder Bolt in the proper location, rotate the Carrier. This is to check freedom of rotation and recheck the timing.



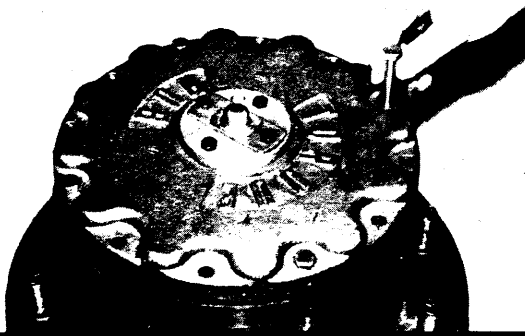
24. Another thrust washer/thrust bearing set is now installed into the counterbore in the face of the carrier.



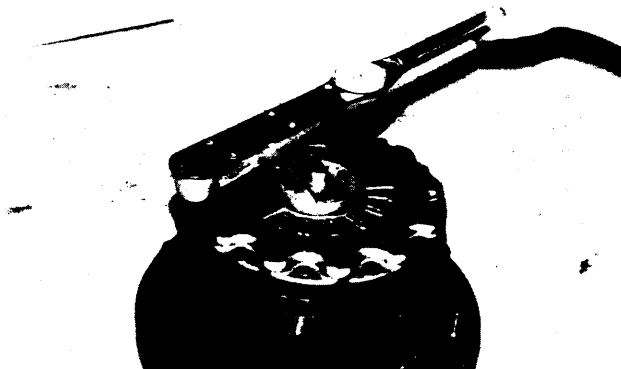
25. Place O'Ring into cover assembly counterbore. Slight stretching may be necessary. Use sufficient grease or petroleum jelly to hold in place.



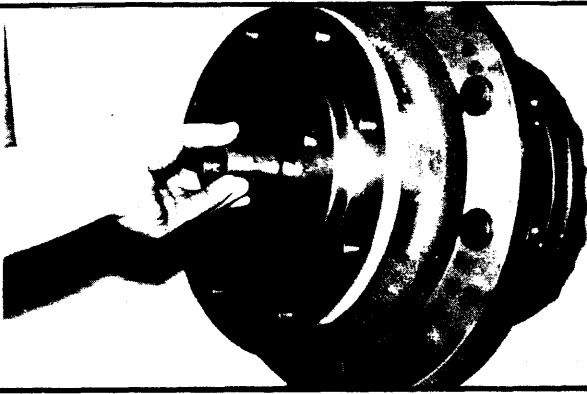
26. Place cover assembly on Ring Gear with oil level, check plug in cover located approximately 90° from oil fill plug in Hub.



27. Locate four shoulder bolts 90° apart into counterbored hole in Hub which were marked in step 17. Torque each bolt to 47 ft. lbs.



28. Install grade eight bolts into the remaining eight holes and torque all bolts to 47 ft. lbs. Use the 180° to 90° method in torquing all bolts.



29. Place Coupling into the Spindle and onto the Input Shaft.

Note: W3C units must have one external and one internal Snap Ring installed. All units with a "X" on the end of the model number must have two internal Snap Rings with a spacer between them installed in the Coupling.

This completes the assembly. The unit must be filled one-half full of EP 90 lubricant before operation.

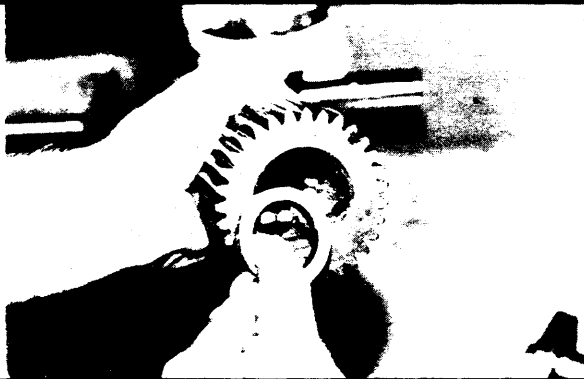
Carrier Sub-Assembly



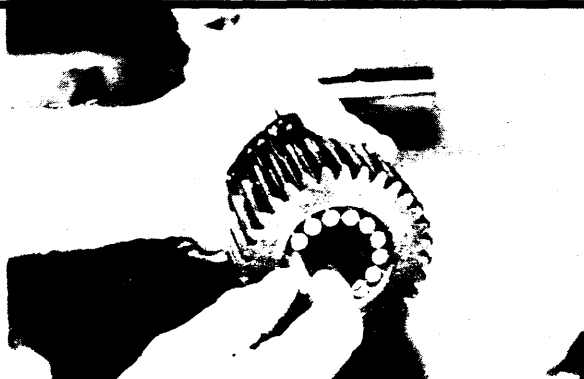
1. Apply a coat of grease or petroleum jelly to Cluster Gear bore.



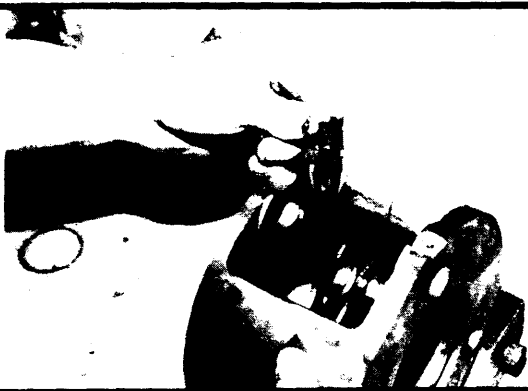
2. Place fourteen Needle Rollers into Cluster Gear bore.



3. Place Spacer washer into opposite side of Cluster Gear and against Needle Rollers.



4. Place second set of fourteen Needle Rollers into Cluster Gear.



5. Apply grease or petroleum jelly to the tang side of two Thrust Washers. Place Thrust Washers against bosses in Carrier with washer tang fitting into slot in Carrier outside diameter.

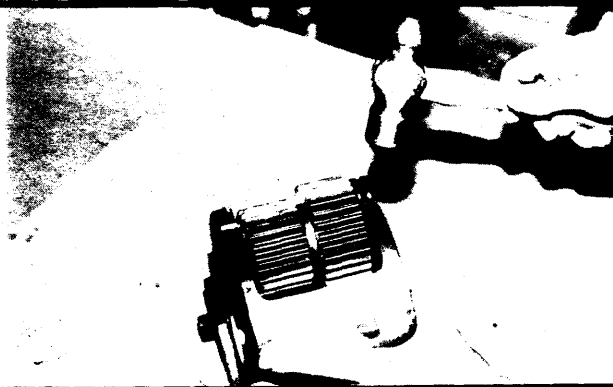
Note: Some old style Carriers will not have slots and tangs should be located inside boss relief.



6. While keeping Thrust Washers in place, slide Cluster Gear into Carrier with the larger gear on the side with the small pin hole.



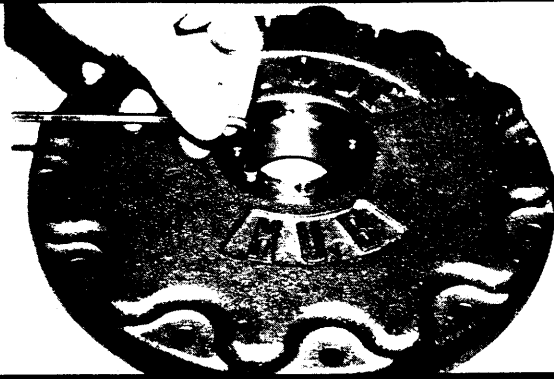
7. Line up Cluster Gear and thrust Washers with hole in Carrier and slide Planet Shaft through. Line up chamfered side of hole in Planet Shaft with pin hole in Carrier.



8. Drive Anti-Roll Pin flush into Carrier hole, thereby locking Planet Shaft into place.

Repeat these steps for remaining two Cluster Gears to complete Carrier Sub Assembly.

Cover Sub-Assembly



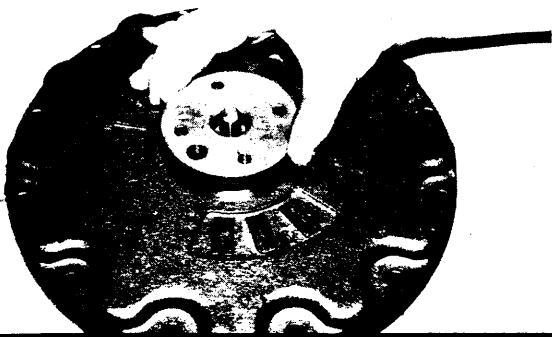
1. Screw Pipe Plug into Cover.



2. Place 'O' Ring into Cover Cap internal groove. The Disconnect Rod may be used to push 'O' Ring into groove. Rod will be held in place by friction from the 'O' Ring.



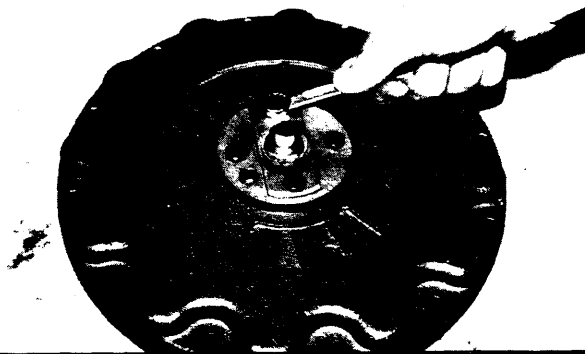
3. Slip 'O' Ring over Cover Cap and against face.



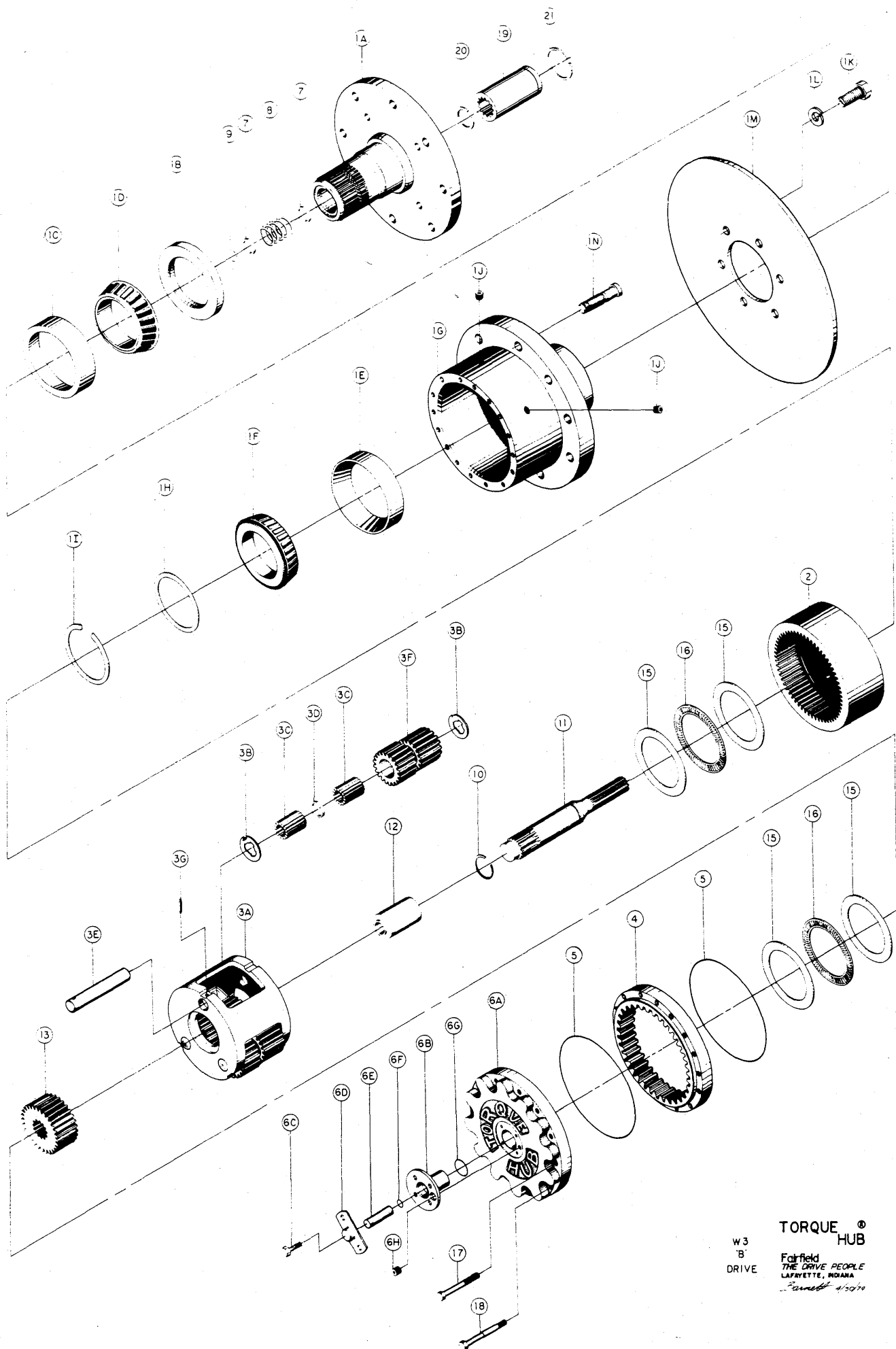
4. Place Cover Cap into Cover with large hole located over Pipe Plug.



5. Install two $1/4 \times 20 \times 3/4$ bolts 180° apart and torque to 70 - 80 in. lbs.

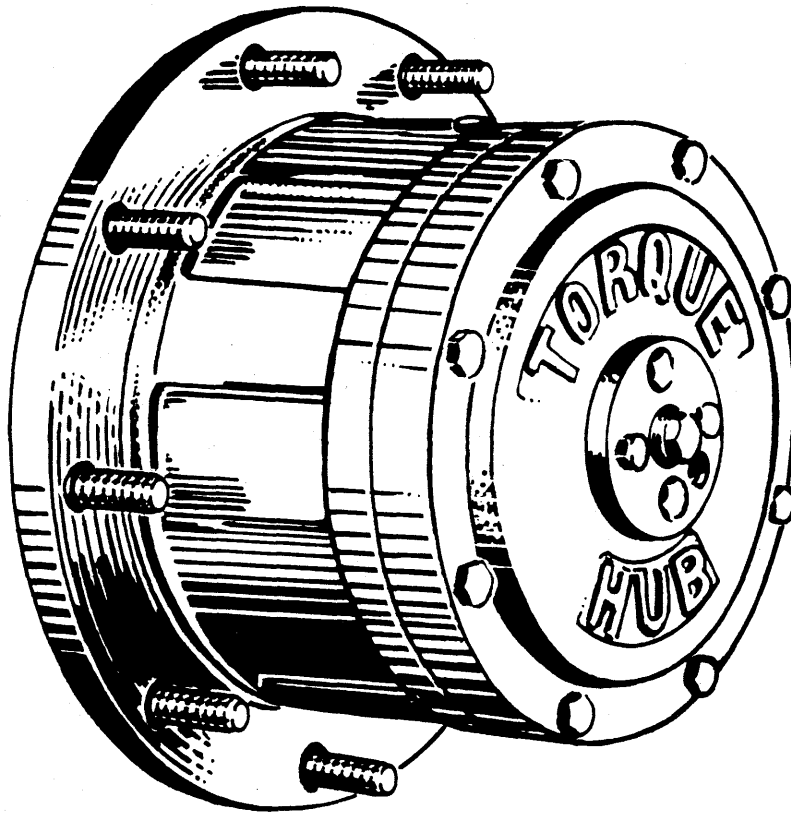


6. Place disconnect cap over cover cap with nipple facing out and align with two open holes. Secure disconnect cap to cover with two $1/4 \times 20 \times 3/4$ and 70 - 80 in. lbs.
-



W3
 'B
 DRIVE

TORQUE HUB
 Fairfield
 THE DRIVE PEOPLE
 LAFAYETTE, INDIANA
 4/50/70



FOR MATERIAL HANDLING EQUIPMENT, FARM MACHINERY, ROAD EQUIPMENT, MINING MACHINERY, ETC.

Fairfield Manufacturing Company, Inc.

South Concord Road, Lafayette, Indiana 47902, U.S.A. 317/474-3474

Fairfield

THE
DRIVE
PEOPLE

CONDOR MODELS 50 AND 56TORQUE HUB, CALAVAR PART NO. 21486

<u>ITEM</u>	<u>PART NO.</u>	<u>QTY.</u>	<u>DESCRIPTION</u>
1	W3B110	1	HUB-SPINDLE SUB-ASSEMBLY
	1A	3400702	1 Spindle
	1B	3501301	1 Seal
	1C	3500803	1 Brg. Cup (JM716610)
	1D	3500804	1 Brg. Cone (JM716649)
	1E	3500805	1 Brg. Cup (JM515610)
	1F	3500806	1 Brg. Cone (JM515649)
	1G	3500601	1 Hub
	1H	3900904	1 Spacer
	1I	910002	1 Retaining Ring
	1J	950003	2 Pipe Plug
	1N	970001	10 Stud
2	3400079	1	INTERNAL GEAR
3	3200031	1	CARRIER ASSEMBLY
	3A	3200505	1 Carrier
	3B	3200305	6 Thrust Washer
	3C	3200801	84 Needle Roller
	3D	3201001	3 Spacer
	3E	3200101	3 Planet Shaft
	3F	3300031	3 Cluster Gear
	3G	920001	3 Roll Pin
4	3500085	1	RING GEAR
5	3940001	2	"O" RING
6	3500402A	1	COVER ASSEMBLY
	6A	3500402	1 Cover
	6B	3900402	1 Cover Cap
	6C	930004	4 Bolt
	6D	3900401	1 Disconnect Cap
	6E	3900101	1 Disconnect Rod
	6F	940001	1 "O" Ring
	6G	940003	1 "O" Ring
	6H	950001	1 Pipe Plug

CONDOR MODELS 50 AND 56
TORQUE HUB, CALAVAR PART NO. 21486

<u>ITEM</u>		<u>PART NO.</u>	<u>QTY.</u>	<u>DESCRIPTION</u>
	6J	901201	1	ID Plate
	6K	930301	4	Drive Screw
7		3901004	2	WASHER
8		3901501	1	SPRING
9		910003	1	RETAINING RING
10		910016	1	RETAINING RING
11		3100109	1	INPUT SHAFT
12		3901001	1	THRUST SPACER
13		3100023	1	INPUT GEAR
15		3200306	4	THRUST WASHER
16		3200307	2	THRUST BEARING
17		930102	8	BOLT
18		3930201	4	SHOULDER BOLT
19		3100205	1	COUPLING

CONDOR MODELS 58, 68 AND 76
TORQUE HUB, CALAVAR PART NO. 21492

<u>ITEM</u>	<u>PART NO.</u>	<u>QTY.</u>	<u>DESCRIPTION</u>
1	W3B110	1	HUB-SPINDLE SUB-ASSEMBLY
	1A	3400702	1 Spindle
	1B	3501301	1 Seal
	1C	3500803	1 Brg. Cup (JM716610)
	1D	3500804	1 Brg. Cone (JM716649)
	1E	3500805	1 Brg. Cup (JM515610)
	1F	3500806	1 Brg. Cone (JM515649)
	1G	3500601	1 Hub
	1H	3900904	1 Spacer
	1I	910002	1 Retaining Ring
	1J	950003	2 Pipe Plug
	1N	970001	10 Stud
2	3400081	1	INTERNAL GEAR
3	3200001	1	CARRIER ASSEMBLY
	3A	3200505	1 Carrier
	3B	3200305	6 Thrust Washer
	3C	3200801	84 Needle Roller
	3D	3201001	3 Spacer
	3E	3200101	3 Planet Shaft
	3F	3300001	3 Cluster Gear
	3G	920001	3 Roll Pin
4	3500085	1	RING GEAR
5	3940001	2	"O" RING
6	3500402A	1	COVER ASSEMBLY
	6A	3500402	1 Cover
	6B	3900402	1 Cover Cap
	6C	930004	4 Bolt
	6D	3900401	1 Disconnect Cap
	6E	3900101	1 Disconnect Rod
	6F	940001	1 "O" Ring
	6G	940003	1 "O" Ring
	6H	950001	1 Pipe Plug

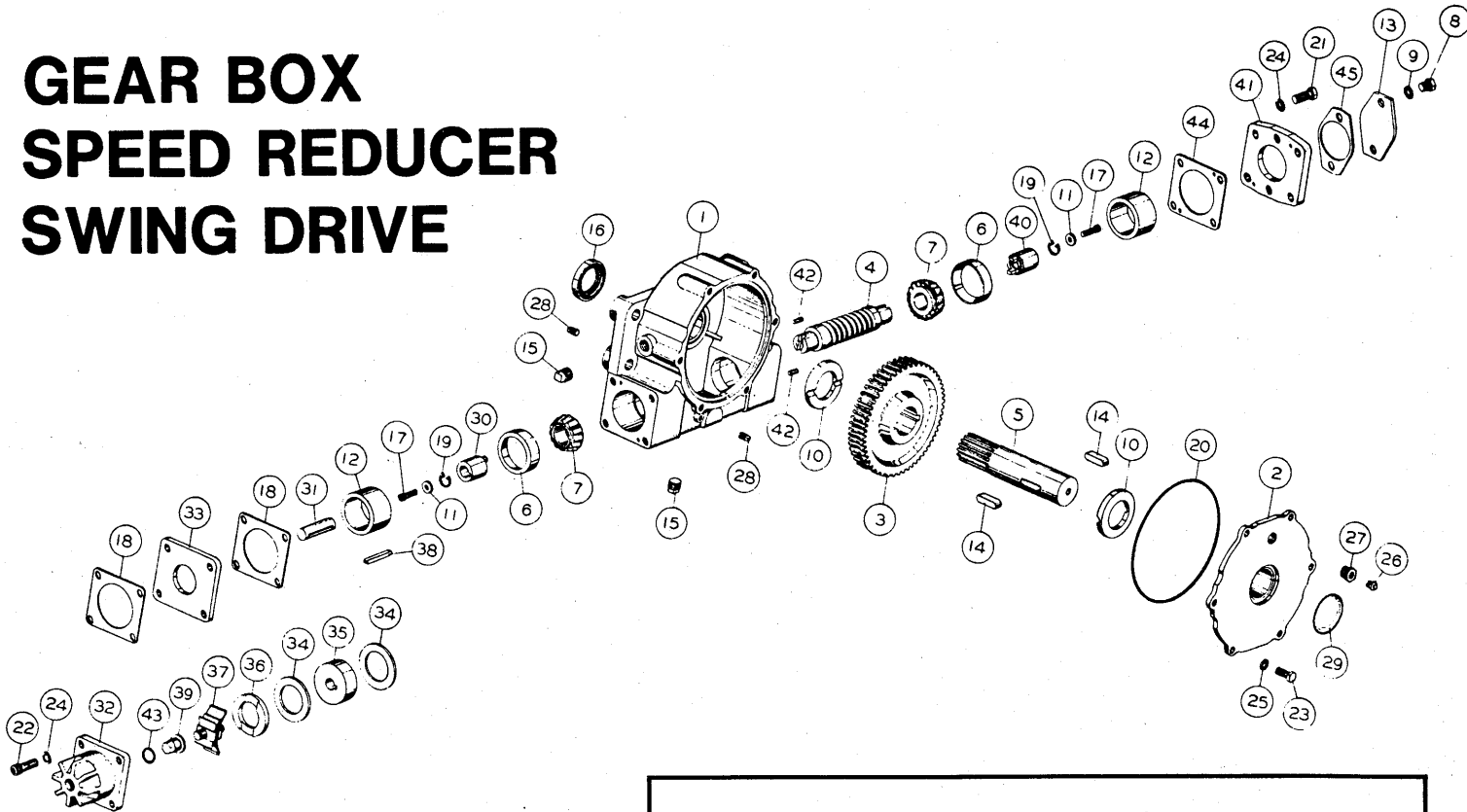
CONDOR MODELS 58, 68 AND 76
TORQUE HUB, CALAVAR PART NO. 21492

<u>ITEM</u>		<u>PART NO.</u>	<u>QTY.</u>	<u>DESCRIPTION</u>
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12		3901001	1	THRUST SPACER
13		3100023	1	INPUT GEAR
15		3200306	4	THRUST WASHER
16		3200307	2	THRUST BEARING
17		930102	8	BOLT
18		3930201	4	SHOULDER BOLT
19		3100205	1	COUPLING

BRADEN

BR 30

GEAR BOX SPEED REDUCER SWING DRIVE



BR30 MATERIAL LIST VARIABLES

BR30 — 1 & 2 Swing Drive			
Item	Part No.	Qty. For One Unit	Catalog No. & Description
13	21959	1	Dust Shield
22	21135	4	Capscrew
30	23651	1	Brake Coupling
35	23480	1	Brake Rotor
40	23654	1	Motor Coupling
41	23655	1	Motor Adapter
45	23108	1	Motor Gasket
46	10009	2	5050 05PH5 Capscrew

BR30 — 3 & 4 Swing Drive			
Item	Part No.	Qty. For One Unit	Catalog No. & Description
13	21603	1	510481 Plate Cover
22	22583	4	22583 Stud
30	23654	1	Brake Coupling
35	81080	1	MU7-151-0 Rotor Assembly
40	23656	1	Motor Coupling
41	23657	1	Motor Adapter
45	10104	1	520840 Motor Adapter Gasket
46	13566	4	5043P Hex Nut

BASIC MATERIAL LIST BR30

ITEM NO.	DESCRIPTION	PART NO.	QUANTITY FOR ONE UNIT
1	Housing Assembly	81548	1
2	Cover Assembly	81549	1
3	Worm Gear	23476	1
4	Worm	23644	1
5	Output Shaft	23645	1
6	Bearing Cup	22585	2
7	Bearing Cone	22584	2
8	Capscrew	10009	2
9	Lockwasher 1/2	11026	2
10	Thrust Ring	23648	2
11	Retainer	23649	2
12	Bearing Spacer	23650	2
14	Key	23482	2
15	Pipe Plug	18010	2
16	Seal	23483	1
17	Capscrew	23857	2
18	Gasket	21640	2
19	Snap Ring	11454	2
20	O-Ring	21033	1
21	Capscrew	21253	4
23	Capscrew	11766	6
24	Lockwasher 7/16	11025	8
25	Lockwasher 5/16	11024	6
26	Relief Valve	10074	1
27	Reducer Bushing	18066	1
28	Pipe Plug	18009	2
29	Expansion Plug	11412	1
31	Brake Shaft	23652	1
32	Brake Cover	21591	1
33	Brake End Plate	23653	1
34	Friction Disc	11426	2
36	Pressure Plate	11431	1
37	Spring Assembly	81081	1
38	Key	18030	1
39	Worm Brake Adjustment Nut	11599	1
42	Dowel Pin	22471	2
43	O-Ring	12465	1
44	Gasket	23669	1



BRADEN WINCH CO.

A DIVISION OF **MACOR**
PHONE: 918 — 251-8511 • BROKEN ARROW, OKLAHOMA 74012



ROTARY ACTUATOR (Calavar Part No. 68425)

FOR 180° PLATFORM ROTATION OPTION:

MAINTENANCE INSTRUCTIONS

(Refer to Figure 35A)

GENERAL

The Rotary Actuators are designed for a maximum operating pressure of 3,000 p.s.i. non-shock load.

The rotator consists of a Pinion, #18, to which a shaft attaches and one (1) Rack, #17, combined with Piston, #9, located within a Housing, #19, Cylinders, #16, and End Caps, #5.

Pressurization of the port(s) results in pinion rotation.

The gear chamber has been packed with a moly grease with a minimum MOS₂ contents of 3% which is sufficient for one to two million cycles.

In the event that maintenance is required, the steps outlined below should be followed.

A. INSPECTION AND REPLACEMENT OF END CAP SEALS, #7

1. Place actuator in the mid-stroke position. Remove Nuts, #14, from Tie Rods, #15.
2. Pull End Cap, #5, free from Cylinder, #16.
3. Inspect or replace O-Ring, #7, and Back-Up Ring, #6. Locate the O-Ring toward the pressure side of the End Cap and lubricate Seal and End Cap before re-installing.
4. Replace End Cap, #5, into Cylinder, #16, and assemble Nuts, #14, to Tie Rods, #15.

B. INSPECTION AND REPLACEMENT OF PISTON SEALS, #10

1. Repeat Steps A1 and A2.
2. Remove Rack Bolt, #8.

B. Inspection and Replacement of Piston
Seals, #10 - continued:

3. Screw two (2) eye bolts or threaded rods in the tapped holes in Piston, #9; use #10-24 UNC threads.
4. Pull Piston, #9, from Cylinder, #16.
5. Replace Piston Seal, #10, making certain the O-Ring portion of the Piston Seal faces the pressure side.
6. Inspect and replace (if necessary) Rack Bolt O-Ring, #11, and Back-Up Ring, #12. Locate the O-Ring, #11, toward the pressure side of the Piston.
7. Replace Piston, #9, into Cylinder, #16, until Piston is tight against end of Rack, #17. To ease Piston installation and to protect Piston Seals, cylinder bore should be coated with suitable oil.
8. Re-assemble Rack Bolt.
9. Repeat Steps A3 and A4.

C. INSPECTION AND REPLACEMENT OF PINION AND BUSHING O-RING, #1 AND #3

1. Remove Snap Ring, #4.
2. Force Bushings, #2, and Pinion, #18, from Housing, #19.
3. Inspect or replace O-Ring, #1 and #3. Put oil or O-Ring lube on seals and bushings.
4. Replace Bushings, #2, and Pinion, #18, into Housing, #19.
5. Replace Snap Rings, #4.

D. COMPLETE DISASSEMBLY OF ACTUATOR

1. Repeat Steps A1 and A2.
2. Repeat Steps B2, B3 and B4.
3. Remove Cylinder, #16, from Housing, #19.
4. Repeat Steps C1 and C2.
5. CAUTION: Before removing rack from housing, with actuator still in mid-stroke position, match mark the center valley of rack to assure the right timing after re-assembly.
6. Push rack from either end to remove from housing.

E. RE-ASSEMBLY OF ACTUATOR

1. Follow previous procedures for re-assembling of all actuator parts and refill the gear chamber with a moly grease with a minimum MOS_2 contents of 3%.

NOTE: Tightening torques for:

- Tie Rod Nut, #14 = 20 lbs-ft.
- Rack Bolt, #8 = 55 lbs-ft.

FIGURE 35A 180° ROTARY ACTUATOR (with hollow pinion) #68425

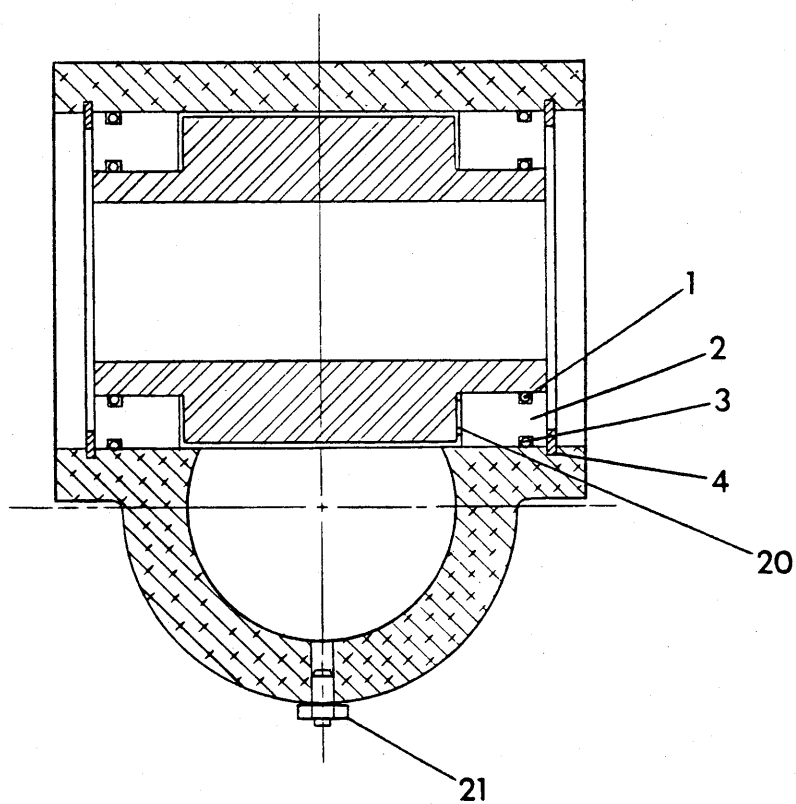
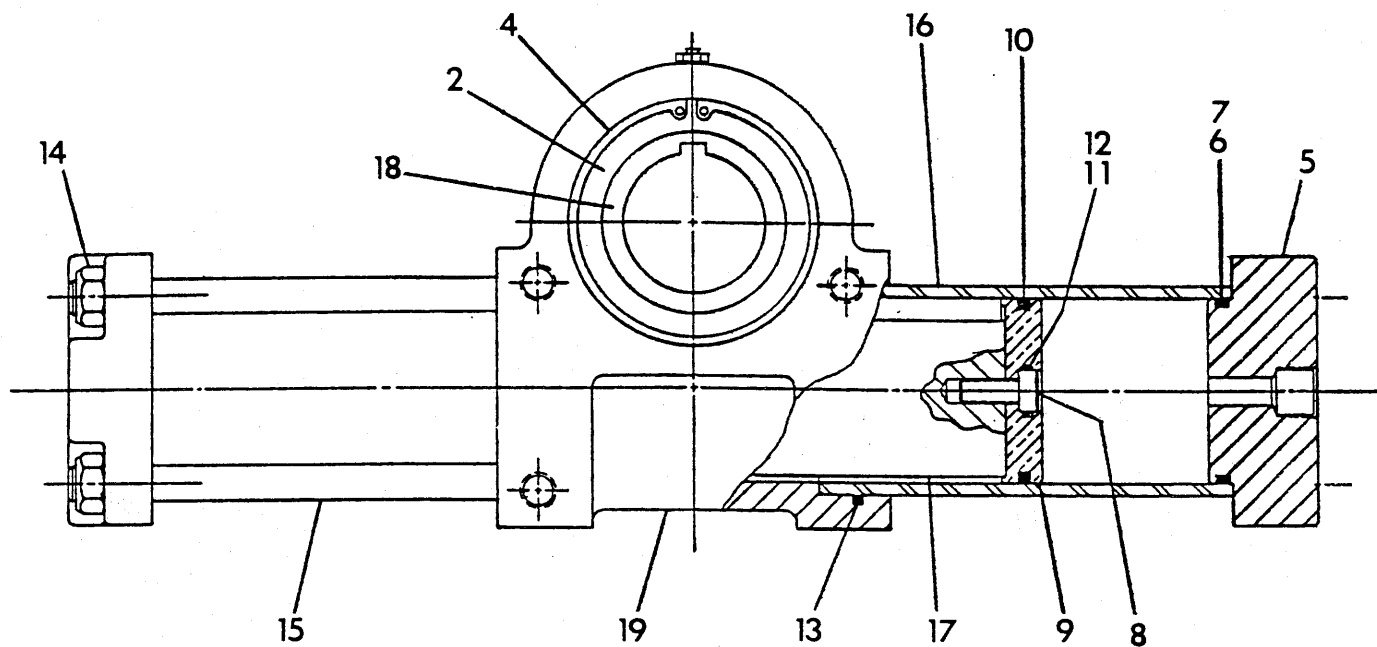
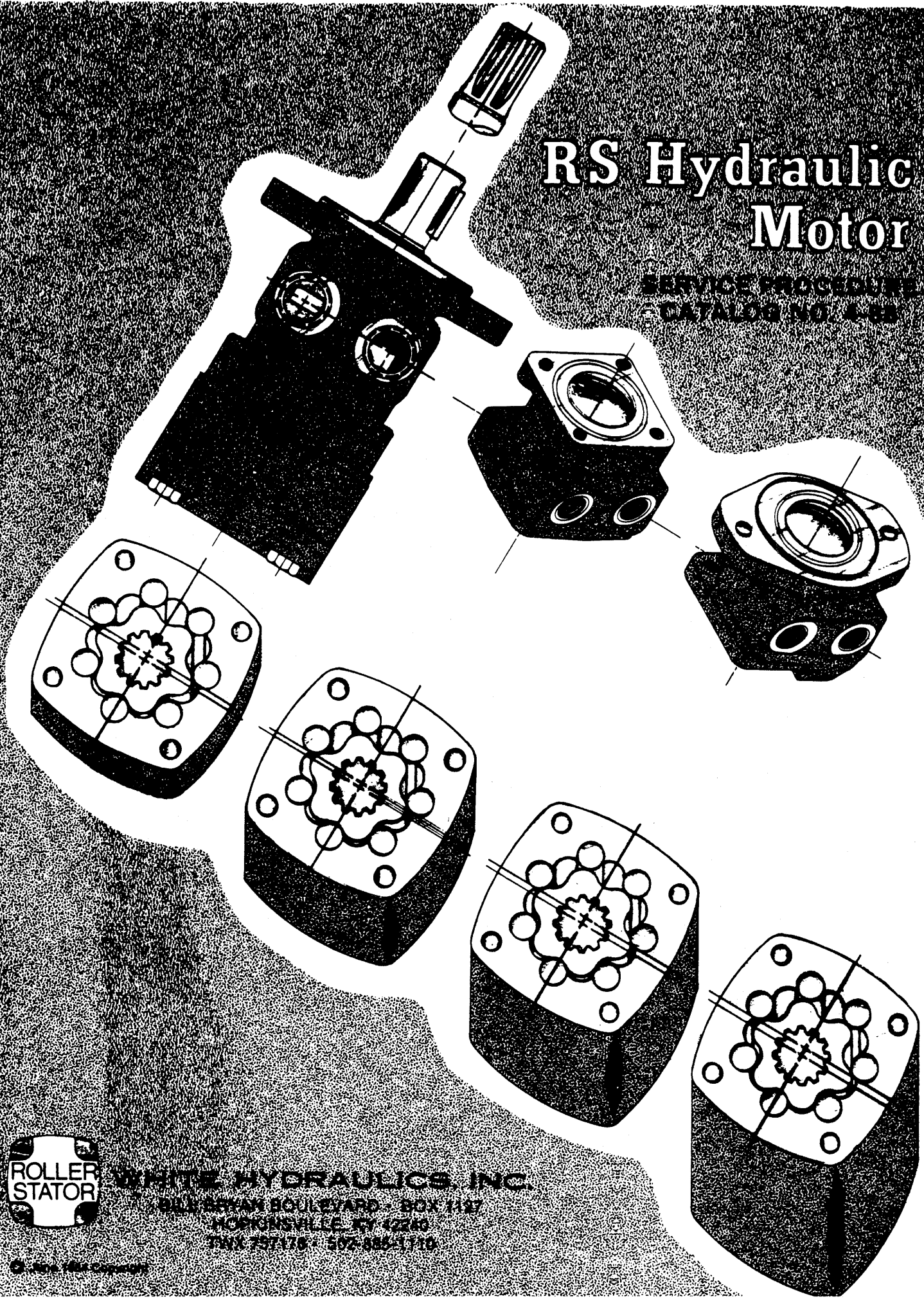


FIGURE 35A 180° ROTARY ACTUATOR (with hollow pinion) #68425

REF	DESCRIPTION	PART NUMBER	QTY
1	O-Ring (Pinion)	*	2
2	Bushing (Pinion)	93049	2
3	O-Ring (Pinion Bushing)	*	2
4	Snap Ring	93050	2
5	End Cap	93051	2
6	Back-up Ring (End Cap)	*	2
7	O-Ring (End Cap)	*	2
8	Rack - Bolt	93052	2
9	Piston	93053	2
10	Piston Seal	*	2
11	O-Ring (Rack - bolt)	*	2
12	Back-up Ring (Rack - bolt)	*	2
13	O-Ring (Cylinder Tube)	*	2
14	Nut (Tie-rod)	93054	8
15	Tie Rod	93055	8
16	Cylinder Tube	93056	2
17	Rack	93057	1
18	Pinion	32683	1
19	Housing	93058	1
20	Thrust Ring	93060	2
21	Relief Valve	93059	1
<p>* Seal Kit, Calavar Part No. 93044, includes Items 1, 3, 6, 7, 10, 11, 12, & 13</p>			

RS Hydraulic Motor

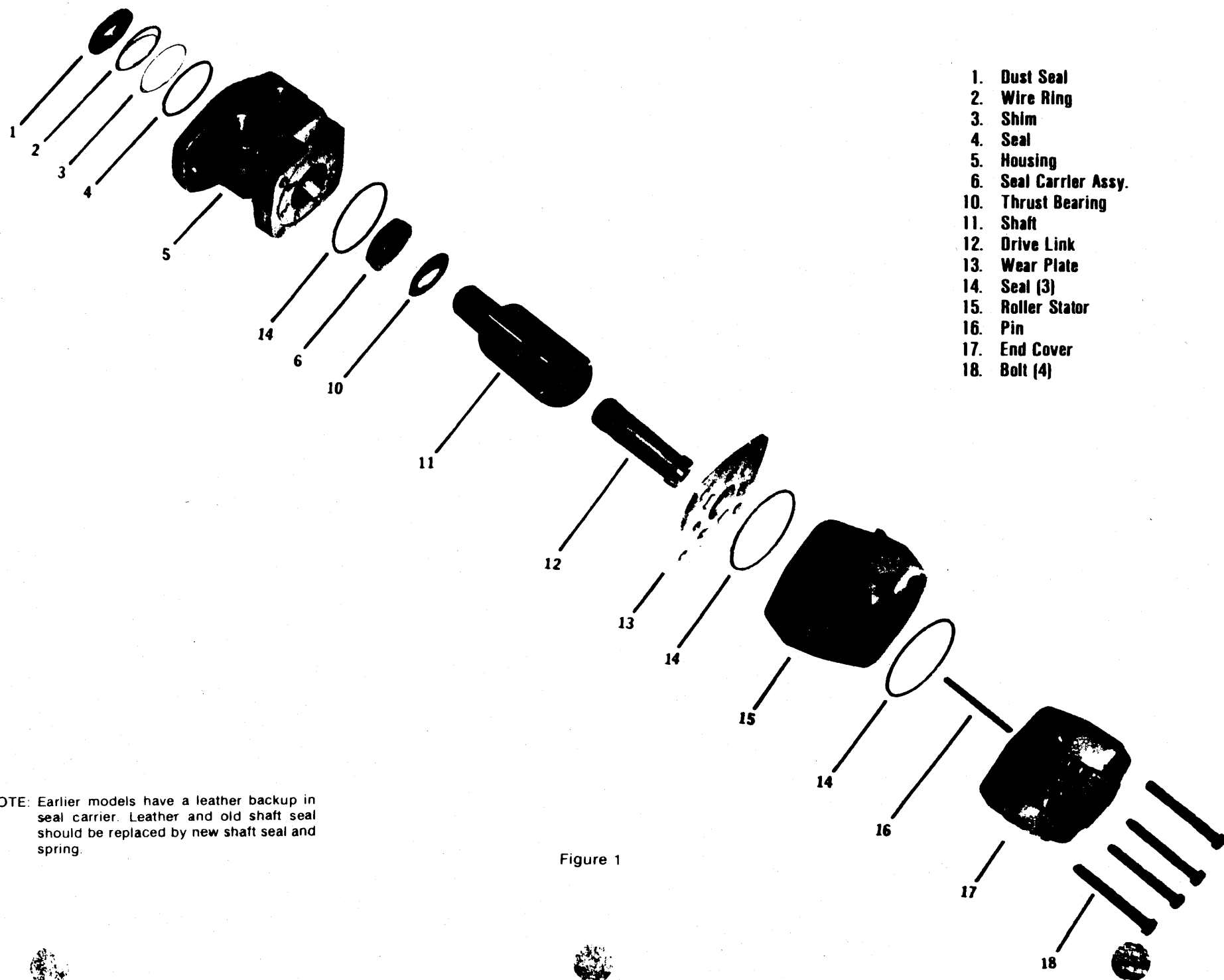
SERVICE PROCEDURES
CATALOG NO. 4-88



WHITE HYDRAULICS, INC.

5111 BRYAN BOULEVARD - BOX 1117
HOPKINSVILLE, KY 42240
TWX 797175 - 502-885-1710

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*NOTE: Earlier models have a leather backup in seal carrier. Leather and old shaft seal should be replaced by new shaft seal and spring.

Figure 1

SERVICE PROCEDURE

Disassembly Procedure . . .

Prior to removing roller stator motor from unit, clean off all dirt. Disconnect hydraulic connections and plug ports. Remove the motor from unit. After removal, wash the motor with solvent to remove all excess dirt from outside of the motor. Remove the woodruff key from shaft (11), place the motor in a vise as shown in Fig. 2 taking care to clamp at port area of housing (see Fig. 2). Place newspapers or a sheet of cardboard on top of bench to obtain a clean work area.

DISASSEMBLY OF ROLLER STATOR

(reference Fig. 1)

1. Remove four bolts (18) [9/16 socket or boxed end] and end cover (17).
 2. Shift wear plate to clear end of drive link and lift group [rotor assembly (15) and wear plate (13)] from housing assembly (5).
 3. Remove shaft (11) and drive link (12) from housing by pushing up on shaft end with palm of one hand and lifting shaft with the other hand. Items 6, 10, 11, 12 and 16 usually will come out from assembly.
 4. Remove housing (5) from vise and place upside down on work bench. This allows thrust bearing (10) to fall free. Next place fingers through dust seal (1) of housing and push seal carrier (6) out the opposite end from the dust seal. Care should be taken to keep the seal carrier from marring the housing bore. This procedure will remove items 6 and 10 from housing.
 5. Mount housing assembly (5) in vise, using the grip end of a large screw driver, tap dust seal (1) until it falls free.
 6. With small screw driver remove retaining ring (2), seal (4) and shim (3).
6. Assemble the drive link (12) into shaft (11). Care must be taken to align mark at root of drive link tooth with mark on cupped end of shaft. See Fig. 3. Fill drive link end with grease. Note, if markings are indistinguishable the root of the drive link tooth should be placed with the deeper slot of the output shaft to the right and 1/4" thru hole to the left. (Mark alignment as described on drive link end with soft pencil if no marks appear.)
 7. Slide output shaft assembly (6, 10, 11 and 12) into housing Fig. 4. (Shaft must be flush or slightly below housing.)
 8. Place lightly oiled seal (14) in groove of housing.
 9. Place wear plate (13) on top of drilled end of housing, insuring alignment of seven feed holes. See Fig. 5. Note alignment groove of wear plate to be in direction of ports.
 10. Install lightly oiled seal (14) into groove of roller stator (15). With seal side down place roller stator (15) over drive link with mark on drive link root in line with rotor valley (min. diameter). See Fig. 6. Mark on stator must be in line with slot in wear plate. Note alignment of seven feed holes with wear plate and housing. See Fig. 7. Align four bolt holes with housing. Care must be taken to insure that seal stays in place. Note: Counterbore on rotor is away from housing.

LONG MILLED OR
ANGLE DRILLED
SLOT



Fig. 3

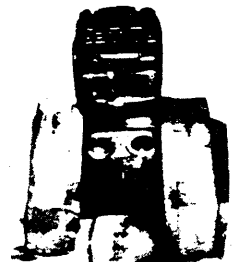


Fig. 2

ASSEMBLY PROCEDURE

(reference Fig. 1)

IMPORTANT

Before assembling, wash all parts off in clean solvent. It is advisable to use a new seal kit containing items 1, 3, 4 and 14 (3 seals).

1. Place housing with mounting flange end up on newspaper, install seal (4) in groove.
2. Install shim (3) into groove next to seal.
3. Push retaining ring (2) into position.
4. Place housing (5) in vise as shown in Fig. 4 with groove side up clamping at ports.
5. Place thrust bearing (10) on shaft (11) followed by the seal carrier assembly (6) with large diameter of seal carrier towards thrust bearing.

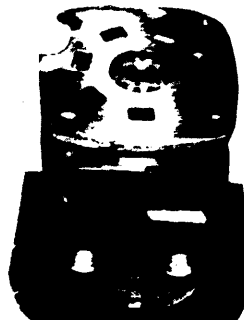


Fig. 5

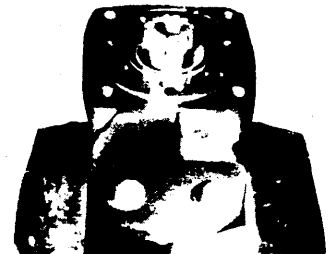


Fig. 4

16. Place assembly on side (ports up) in vise and rotate shaft with key in place and check to insure the suction port is in the same direction of rotation.



Fig. 6

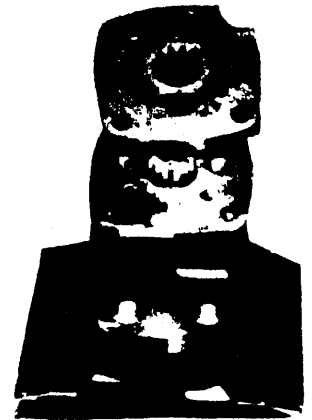
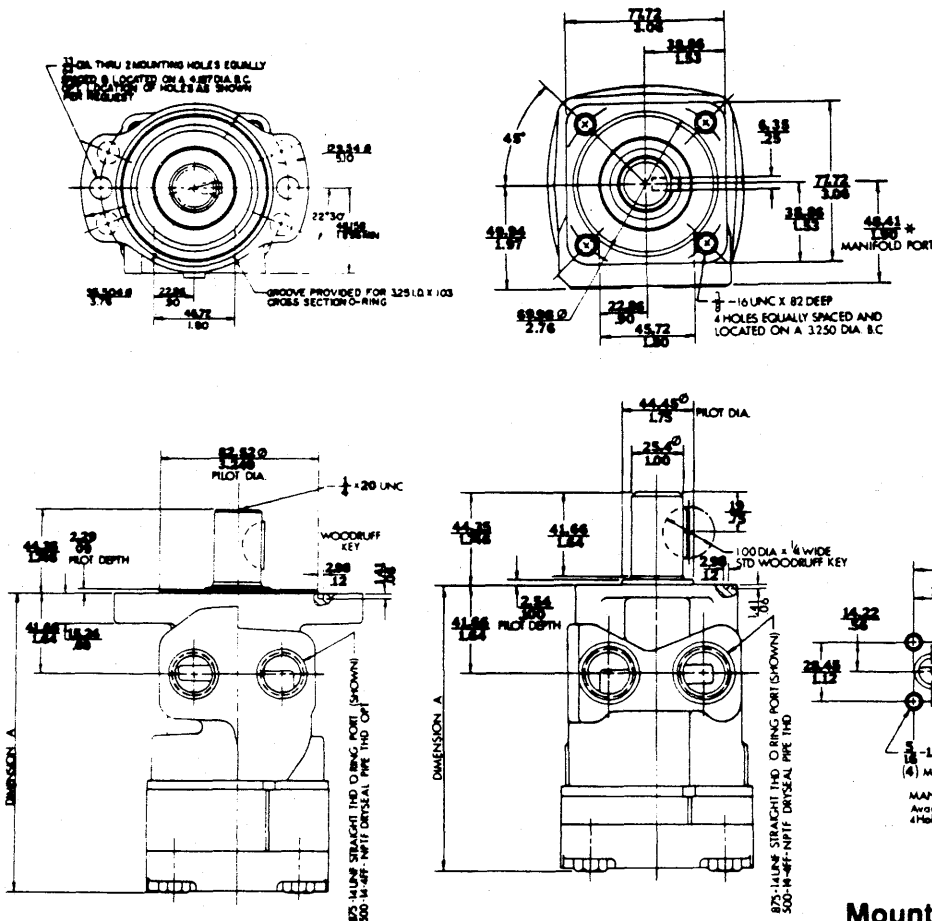


Fig. 7



**DIMENSIONAL VALUES SHOWN
ARE REFERENCE**

MILLIMETER
INCH

WHITE HYDRAULICS, INC.
TELEPHONE 502-885-1110
P.O. BOX 1127
HOPKINSVILLE, KY 42240

TWX 757176 Attn: White Co.

Mounting Dimensions

MOTOR SERIES	DISPLACEMENT		DIMENSION "A"			
			4 Hole Flange		2 Hole Flange	
	Cu.In./Rev.	Cu.Cm./Rev.	In.	mm	In.	mm
RS-AA-1	3	50	5.41	137.41	5.41	137.41
RS-AB-1	4.5	74	5.41	137.41	5.41	137.41
RS-AC-1	6.8	110	5.53	137.41	5.53	137.41
RS-AE-1	10	164	5.87	155.45	5.87	155.45
RS-AG-1	12	200	6.12	155.45	6.12	155.45
RS-AK-1	14.6	268	6.66	169.16	6.66	169.16
RS-AM-1	18	295	6.66	169.16	6.66	169.16
RS-AP-1	24	393	7.37	187.20	7.37	187.20



WHITE HYDRAULICS, INC.

Bill Bryan Boulevard
Box 1127, Hopkinsville, KY 42240
502-885-1110 / TWX 757176
FAX 502-886-8462

JULY 11, 1988

SERVICE BULLETIN

HS & RS SERIES SERVICE AND SEAL KIT INSTALLATION

THESE INSTRUCTIONS COVER BOTH THE HS & RS SERIES MOTORS. NOTE CAREFULLY THE DIFFERENT TIMING PROCEDURES FOR EACH SERIES.

PRIOR TO DISASSEMBLY, CLEAN OFF THE EXTERIOR OF THE MOTOR IF NECESSARY AND MARK A VERTICAL LINE UP ONE SIDE OF THE MOTOR WITH A FELT MARKER FOR LOCATION REFERENCE WHEN REASSEMBLING.

HAVE A CLEAN WORK BENCH AVAILABLE.

DISASSEMBLY

1. PLACE MOTOR IN VISE AROUND PORT AREA.
2. REMOVE 4 BOLTS AND END COVER.
3. SLIDE WEAR PLATE OFF CENTER AS NECESSARY TO CLEAR THE DRIVE LINK SPLINES AND REMOVE THE ROTOR SET AND WEAR PLATE AS ONE PIECE TO PREVENT ROLLS FROM FALLING OUT.
4. REMOVE DRIVE LINK AND PIN.
5. REMOVE SHAFT UP THROUGH HOUSING. BE CAREFUL NOT TO LOSE THE COOLING PLUG LOCATED INSIDE THE SHAFT.
6. REMOVE HOUSING FROM VISE AND PLACE WITH MOUNTING FLANGE UP ON WORK BENCH. THIS ALLOWS THRUST BEARING (AND THRUST WASHER IN MAY, 1988 AND NEWER MODELS) TO FALL FREE. CAREFULLY INSERT A SCREWDRIVER BETWEEN DUST SEAL AND SEAL CARRIER AND PRY OUT DUST SEAL.
7. PRESS THE SEAL CARRIER BACK THROUGH THE HOUSING, BEING CAREFUL NOT TO SCORE THE HOUSING BORE.
8. REMOVE RETAINING RING, BACK UP SHIM AND LATHE CUT SEAL FROM GROOVE IN HOUSING WITH A SMALL SCREWDRIVER.

REASSEMBLY AND SEAL KIT ASSEMBLY

THIS COVERS REASSEMBLY USING SEAL KIT NUMBER PS222001, WITH VITON SEAL AND THRUST WASHER. PS222001 IS A UNIVERSAL KIT COVERING BOTH HS & RS SERIES MOTORS SO THERE WILL BE 2 EXTRA BODY SEALS LEFT WHEN REASSEMBLY IS FINISHED.

EACH PART SHOULD BE WASHED IN CLEAN SOLVENT PRIOR TO REASSEMBLY. INTERNAL WORKINGS OF MOTOR MUST BE TOTALLY FREE OF DIRT OR DEBRIS. ALL SEALS SHOULD BE LIGHTLY OILED PRIOR TO INSTALLATION.

1. PLACE HOUSING IN VISE WITH MOUNTING FLANGE UP.
2. INSTALL 1.735" I.D. LATHE CUT SEAL.
3. INSTALL BACK-UP SHIM. THIS SHIM MUST BE FOLDED AND BENT SLIGHTLY AND THEN WORKED INTO PLACE WITH A SMALL SCREWDRIVER.
4. INSTALL WIRE RING AND TURN HOUSING OVER SO IT IS IN VISE WITH FLANGE DOWN.
5. SEE ATTACHED DRAWING C10014 FOR INSTALLATION OF SEAL CARRIER COMPONENTS.
6. CAREFULLY SLIDE SHAFT ASSEMBLY INTO HOUSING. BE SURE THE COOLING PLUG IS STILL PROPERLY PLACE IN HOLE IN BOTTOM OF THE SHAFT.

IMPORTANT - TIMING INSTRUCTIONS

(STEPS 7-10) FOR HS MOTOR

7. USE TIMING DOT ON DRIVE LINK END AS A REFERENCE OR MARK ANY SPLINE ROOT WITH A PENCIL. CAREFULLY LOWER DRIVE LINK INTO SHAFT WITH REFERENCE MARK DIRECTLY IN LINE WITH THE CENTER OF ANY OF FOUR THROUGH HOLES IN SHAFT. AS DRIVE LINK SPLINES CONTACT THE SHAFT SPLINES, SLOWLY TURN DRIVE LINKS, COUNTERCLOCKWISE UNTIL SPLINES ENGAGE IN SHAFT SPLINE. TAP LIGHTLY ON DRIVE LINK END TO SEAT THE SHAFT ASSEMBLY INTO THE WIRE SNAP RING. SHAFT END SHOULD BE SLIGHTLY ABOVE FLUSH FLUSH WITH HOUSING SURFACE. (APPROXIMATELY .010"-.020") BUT WILL SEAT AS MOTOR IS BOLTED TOGETHER.
8. INSTALL BODY SEAL INTO GROOVE IN HOUSING.
9. INSTALL BODY SEAL INTO GROOVE IN ROTOR SET.
10. PLACE WEAR PLATE ONTO SEAL SIDE OF ROTOR SET WITH THE CENTER HOLE OF WEAR PLATE DIRECTLY CENTERED ON ROTOR SPLINES. (BE SURE THE WEAR PLATE IS LOCATED SUCH THAT THE NOTCH ON ONE SIDE OF WEAR PLATE PERIMETER WILL LINE UP WITH TAB ON ROTOR SET PERIMETER WHEN BOLT HOLES ARE ALIGNED). LOCATE ANY ONE OF THE FOUR ROTOR SPLINES THAT ARE DIRECTLY ON A CENTER LINE WITH THE HIGH (CONVEX) LOBE OF ROTOR. PLACE THE WEAR PLATE AND ROTOR SET ONTO DRIVE LINK SPLINE AS ONE PIECE WITH THE HIGH LOBE SPLINE ENGAGING THE PREVIOUSLY DETERMINED DRIVE SPLINE. WEAR PLATE SHOULD BE BETWEEN HOUSING AND ROTOR SET. ALIGN PLATE AND ROTOR SET BOLT HOLES WITH HOUSING BOLT HOLES. THE WEAR PLATE NOTCH AND ROTOR SET TAB MUST BE IN LINE AND MUST BE LOCATED ON THE PORT SIDE OF THE HOUSING.

IMPORTANT - RS SERIES TIMING INSTRUCTIONS

SEE STEPS 7-10 FOR HS SERIES TIMING

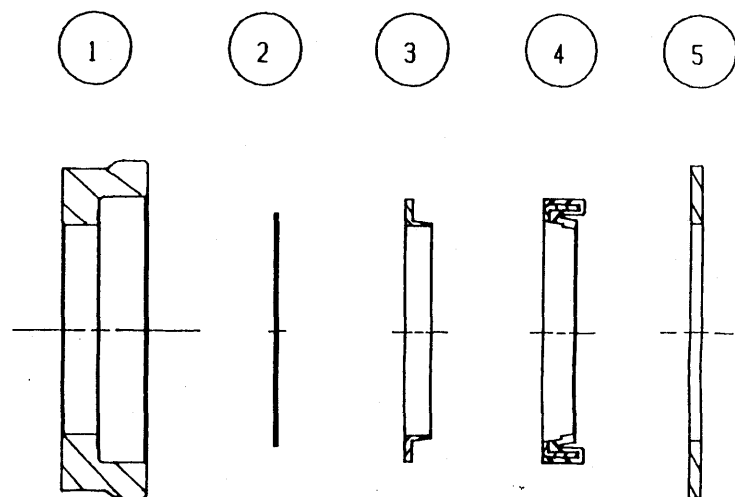
11. USE TIMING DOT ON DRIVE LINK END AS A REFERENCE OR MARK ANY SPLINE ROOT WITH A PENCIL. CAREFULLY LOWER THE DRIVE LINK INTO THE SHAFT WITH REFERENCE MARK DIRECTLY IN LINE WITH THE CENTER OF ANY OF THE 6 THROUGH HOLES IN SHAFT. AS DRIVE LINK SPLINES CONTACT THE SHAFT SPLINES, SLOWLY ROTATE THE DRIVE LINK CLOCKWISE UNTIL SPLINES ENGAGE IN SHAFT SPLINES. (NOTE: THIS APPLIES TO TIMING PROCEDURE FOR MOTORS WITH STANDARD CW ROTATION CODE 'O'. FOR REVERSE CCW ROTATION CODE 'I' ROTATE THE DRIVE LINK CCW UNTIL SPLINE ENGAGES. ROTATION CODE IS SEVENTH DIGIT OF SPEC. NUMBER). TAP LIGHTLY ON DRIVE LINK END TO SEAT THE SHAFT ASSEMBLY INTO THE WIRE RING. SHAFT END SHOULD BE SLIGHTLY ABOVE FLUSH WITH HOUSING SURFACE, BUT WILL SEAT AS MOTOR IS BOLTED TOGETHER.
12. INSTALL BODY SEAL INTO GROOVE IN HOUSING.
13. INSTALL BODY SEAL INTO GROOVE IN ROTOR SET.
14. PLACE WEAR PLATE ONTO SEAL SIDE OF ROTOR SET WITH THE CENTER HOLE OF WEAR PLATE DIRECTLY CENTERED ON ROTOR SPLINES. (BE SURE THE WEAR PLATE IS LOCATED SUCH THAT THE NOTCH ON ONE SIDE OF WEAR PLATE PERIMETER WILL LINE UP WITH TAP PROTRUDING ON ONE SIDE OF ROTOR SET PERIMETER WHEN BOLT HOLES ARE ALIGNED). LOCATE ANY ONE OF THE 6 ROTOR SPLINES THAT ARE DIRECTLY ON A CENTER LINE WITH ANY OF THE 6 ROTOR VALLEYS (MINOR DIAMETER OF ROTOR). PLACE THE WEAR PLATE AND ROTOR SET ONTO THE DRIVE LINK AS ONE PIECE WITH THE ROTOR VALLEY SPLINE ENGAGING THE PREVIOUSLY MARKED DRIVE LINK SPLINE. WEAR PLATE MUST BE BETWEEN HOUSING AND ROTOR SET. ALIGN WEAR PLATE AND ROTOR SET BOLT HOLES WITH HOUSING BOLT HOLES. THE WEAR PLATE NOTCH AND ROTOR SET TAB MUST BE IN LINE AND MUST BE LOCATED ON THE PORT SIDE OF THE HOUSING.
15. PLACE PIN IN DRIVE LINK. NOTE THAT PIN HAS ONE CONVEX END AND ONE CONCAVE END. CONVEX END MUST GO INTO THE DRIVE LINK.
16. INSTALL BODY SEAL INTO END COVER GROOVE AND PLACE THE END COVER ON THE MOTOR SO THAT CONCAVE END OF PIN ENGAGES INTO THE HOLE IN CENTER OF END COVER. ALIGN BOLT HOLES.
17. INSTALL BOLTS AND TORQUE DOWN TO 50 FT. LBS.
18. CHECK TO SEE THAT REF. LINE YOU MARKED ON THE EXTERIOR OF THE MOTOR PRIOR TO DISASSEMBLY, MATCHES UP THROUGH ALL THE PARTS.

C10014 A

SERVICE PROCEDURE SUPPLEMENT FOR SEAL KIT PS222001 W/VITON
SEAL AND THRUST WASHER.

SERVICE PROCEDURE SUPPLEMENT FOR SEAL KIT PS222001 W/VITON
SEAL AND THRUST WASHER.

1. PLACE THRUST BEARING ON SHAFT.
2. PLACE THRUST WASHER (5) ON SHAFT.
3. INSTALL SHAFT SEAL (4) ONTO SHAFT AND DOWN AGAINST THRUST WASHER (5) ORIENTED AS SHOWN. (NOTE: TAKE CARE NOT TO DAMAGE SEAL WHEN SLIDING OVER SHAFT SLINES OR KEYSLOT.)
4. INSTALL TEFLON BACK-UP (3) ONTO SHAFT ORIENTED AS SHOWN. THE LIP ON THE TEFLON BACK-UP (3) SHOULD ENGAGE WITH SHAFT SEAL I.D. (4)
5. INSTALL BACK-UP SHIM (2) ONTO SHAFT AND DOWN AGAINST TEFLON BACK-UP (3)
6. CAREFULLY PUSH THE SEAL CARRIER (1) STRAIGHT DOWN OVER SHAFT SEAL ASSEMBLY, ORIENTED AS SHOWN, TAKING CARE NOT TO COCK THE CARRIER WHILE INSTALLING.
7. RETURN TO STEP 6 OF REASSEMBLY SECTION OF SERVICE PROCEDURE.



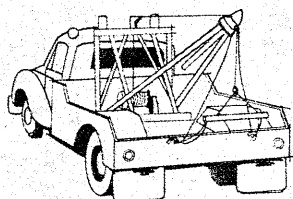
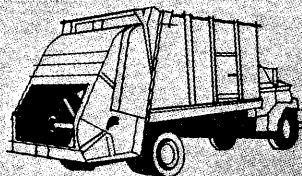
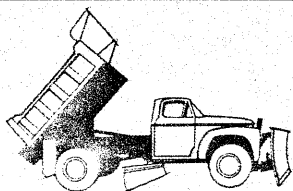
- | | | |
|---|-------------------------|----------|
| 1 | SEAL CARRIER - - - - - | R5018991 |
| 2 | BACKUP SHIM - - - - - | R5018020 |
| 3 | TEFLON BACKUP - - - - - | R5018058 |
| 4 | SHAFT SEAL - - - - - | R5018053 |
| 5 | THRUST WASHER - - - - - | R5018059 |

MUNCIE

our business is power



for INDUSTRIAL HYDRAULIC POWER



Muncie Hydro-Throttle Control is a reliable, automatic, remote control of engine speed for hydraulic power systems. The Muncie STA-9010 model fits all applications. It can be easily and quickly installed on new systems, as well as equipment already in service. No special tools are needed for installation.

To install, just connect the pressure line of the hydraulic system to the Hydro-Throttle Control. When the hydraulic 4-way valve is actuated, system pressure increases, forcing the hydro-throttle piston into action and bringing engine speed to a pre-selected RPM. Return of 4-way valve to neutral position allows engine RPM to return to idle.

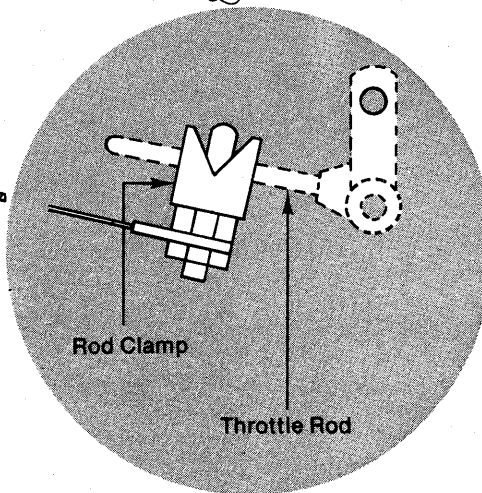
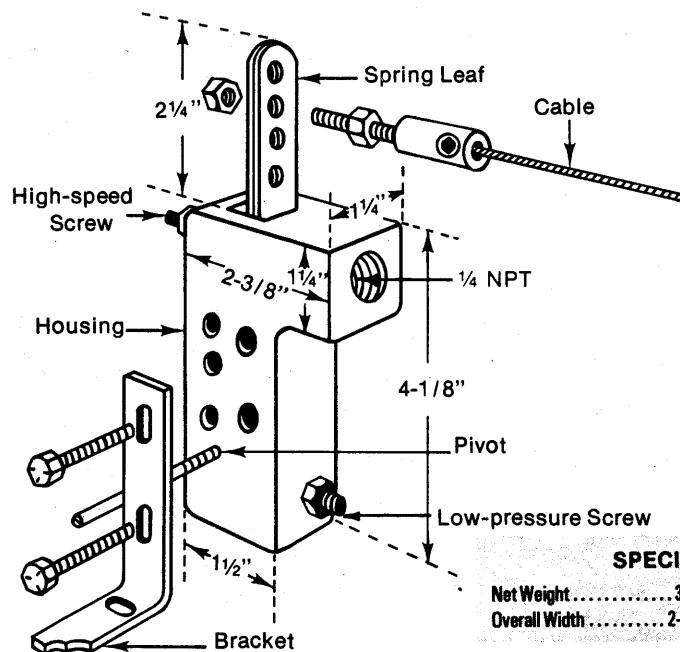
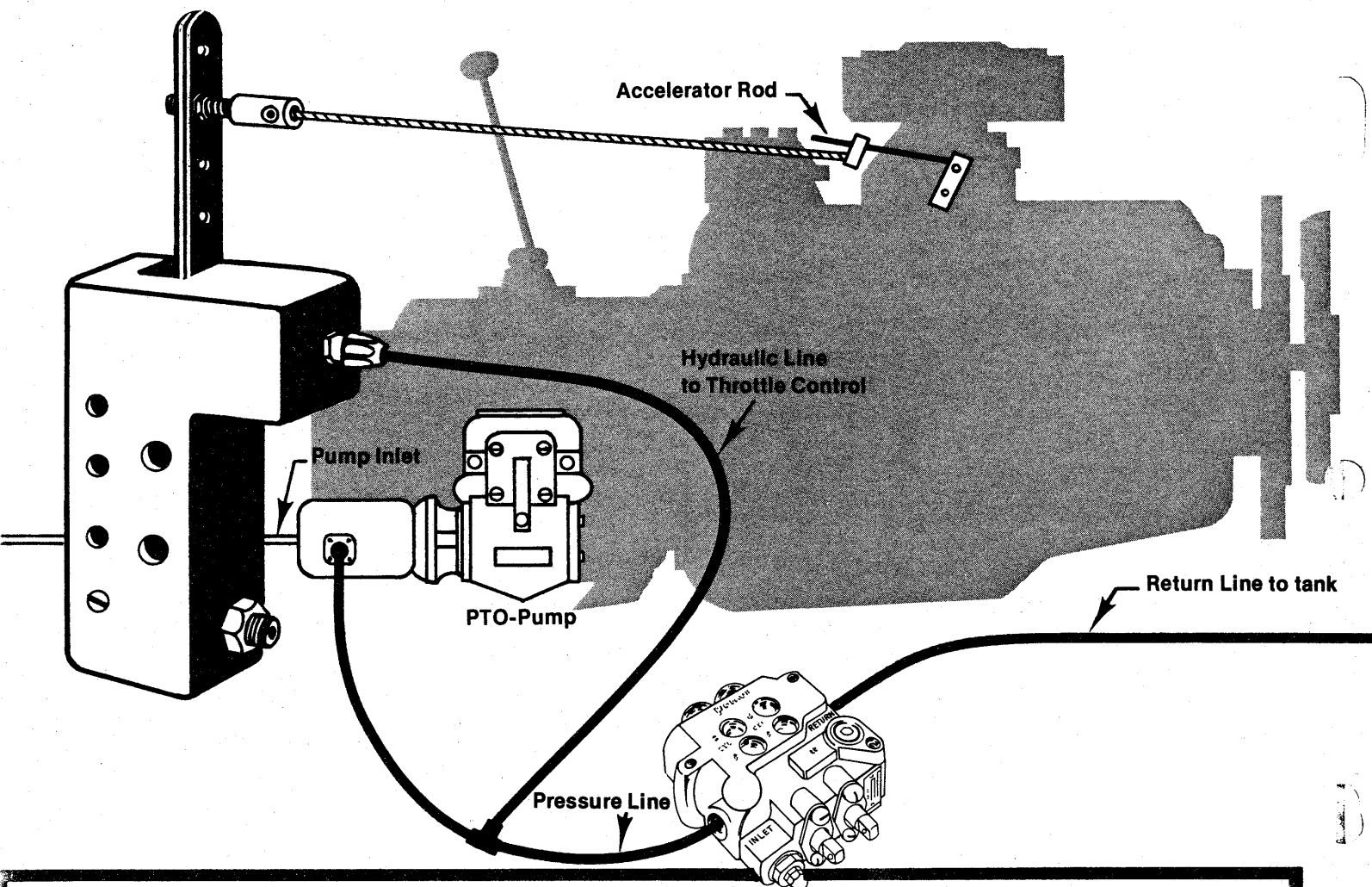
- Automatically increases engine RPM
- Prevents engine stalling
- Improves operating efficiency
- Reduces unnecessary acceleration of engine
- Saves fuel • Saves money
- Permits one man operation
- Easily installed

MUNCIE

MUNCIE PARTS MFG. CO., INC.

MUNCIE • ATLANTA • CHICAGO • SEATTLE • TOLEDO • TORONTO

Automatic remote control of hydraulically operated equipment



- Easily Installed
- No Special Tools Needed
- Compact
- Positive Action
- Fits All Trucks and Industrial Engines
- Mounting Bracket Furnished
- Adjustable
- Efficient
- 4 Optional Pivot Positions For Spring Adjustment

SPECIFICATIONS

Net Weight.....	3 lbs.	Overall Length.....	6-3/8"
Overall Width.....	2-3/8"	Overall Thickness.....	1 1/4"



MUNCIE PARTS MFG. CO., INC.

GENERAL OFFICES
P.O. Box 548 • Muncie, Indiana 47305
Phone (317) 284-7721

SEATTLE
Subsidiary of Muncie Parts Mfg. Co. Inc.
The Blackler Company • 317 So. Bennett St.
Seattle, Wash. 98108 • Ph. (206) 763-2230

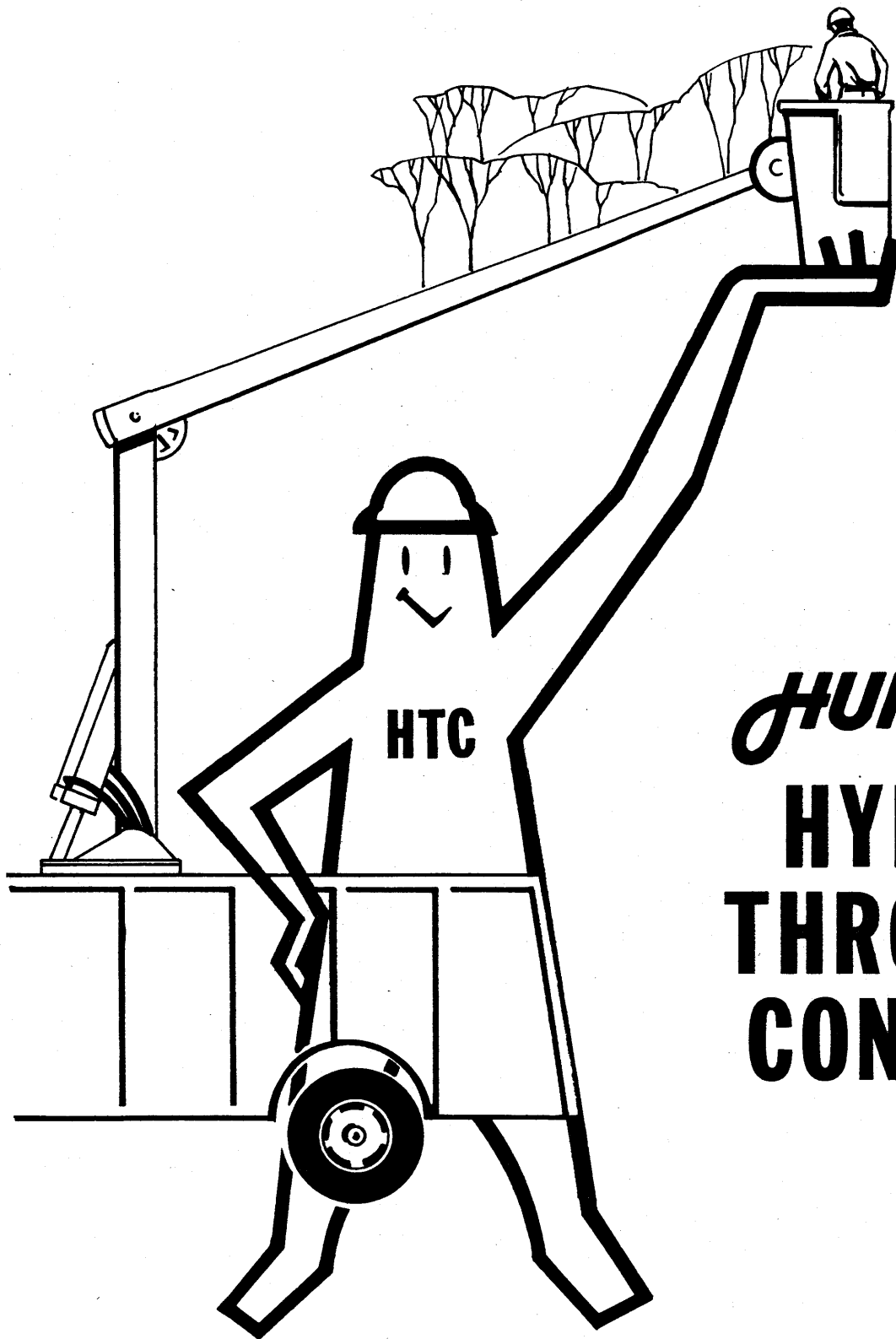
ATLANTA DIVISION
P.O. Box 43468 • Atlanta, Georgia 30336
Phone (404) 349-4402

TOLEDO DIVISION
P.O. Box 6593 • Toledo, Ohio 43612
Phone (419) 729-3861

CHICAGO DIVISION
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Phone (312) 298-6860

MUNCIE CANADA LIMITED
P.O. Box 113, Malton Station
Mississauga, Ontario L4T 3B5
Phone (416) 677-9852

INSTALLATION INSTRUCTIONS



HUNTER **HYDRO- THROTTLE CONTROL**

MUNCIE PARTS MFG. CO., INC.



GENERAL OFFICES
P.O. Box 548 • Muncie, Indiana 47305
Phone (317) 284-7721

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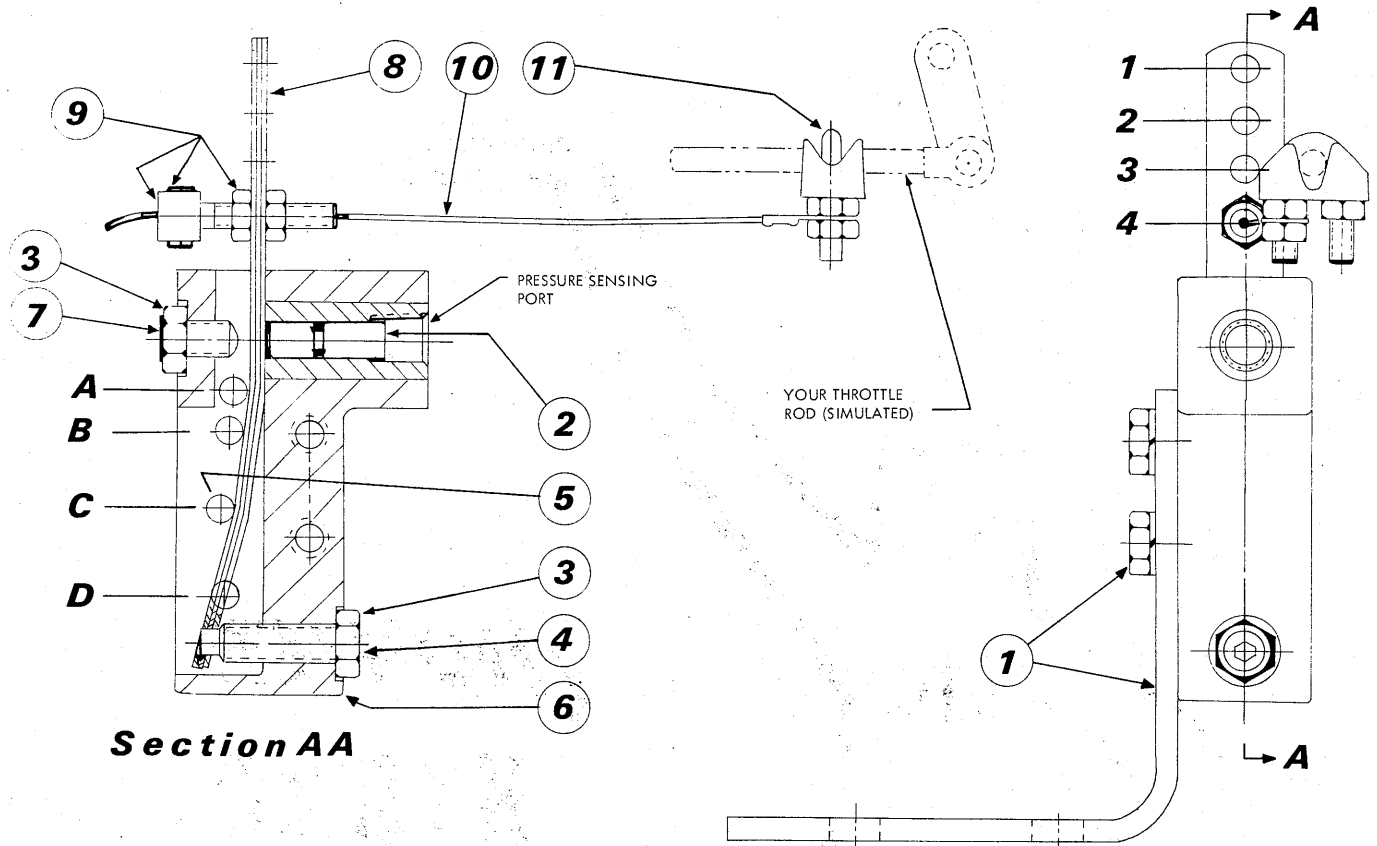
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Phone (312) 298-6860

MUNCIE CANADA LIMITED
P.O. Box 113, Malton Station
Mississauga, Ontario L4T 3B5
Phone (416) 677-9852 • Telex No. 06-968841

PARTS LIST
SERIES 90 THROTTLE CONTROL



Model 1-9010

<u>Item</u>	<u>Part No.</u>	<u>Description</u>
1	2-8124	Bracket and Bolt Assembly
2	2-9002	Piston Assembly
3	5322	Nut, Jam 3/8 - 16
4	5050	Screw 3/8 - 16 x 1-1/4 Spring Tension Adjusting
5	9004	Screw, Fulcrum
6	2-9007	Housing and Liner Assembly
7	5049	Screw 3/8 - 16 x 3/4 Speed Adjusting
8	8118	Spring, Leaf (3 required)
9	1-170211	Rod, Actuating, with Nuts and Set Screws
10	2-170212	Cable Assembly
11	180960	Clamp

I. INSTALLATION OF THE THROTTLE CONTROL

A. Introduction

Refer to sketch shown with parts list, included on page 2.

One Throttle Control can operate an unlimited number of circuits, that are driven by the same pump discharge line in the hydraulic system.

The Throttle Control piston (2) senses the pump discharge line pressure. The pressure increases, and pulls the throttle open, when you operate a circuit to move a load. The pump by-passes, and allows the throttle to close when the valve circuit lever is returned to neutral.

The pressure must increase, above by-passing pressure, at least 15 PSI for each pound of throttle pull, plus the amount your by-passing pressure will vary, due to oil viscosity changes, over your oil operating temperature range.

Highly loaded circuits usually increase the pressure to a level far above the pump by-passing pressure, and produce a motivating force far beyond the minimum required to open the throttle.

Lightly loaded circuits, such as, when the boom is lowering, swing circuits, outriggers lowering, etc., produce the least pressure. The plumbing flow restrictions must be revised in these circuits if the load cannot increase the circuit pressure sufficiently above by-passing pressure to produce the motivating force needed to open the throttle.

The pressure will increase at a greater rate as the engine speed increases because the plumbing relating to the circuits usually contain greater restrictions. A lightly loaded circuit may then become operable at a higher engine speed, if it did not operate at idle.

The motivating force can be increased by revising your plumbing, downstream of the throttle control connection, as follows:

Restrict the plumbing relating to the circuits. (1) Add an orifice. (2) Reduce diameter and/or lengthen line size. (3) Add a two-way check valve with a heavier spring in the direction of flow. This will increase pressure more at idle speed where needed most. It, therefore, is the best type of restriction.

Decrease your by-passing pressure. (1) Remove "bottle necks", and elbows. (2) Increase diameter and/or shorten line size.

B. Mounting Bracket

One is furnished in the kit. Modify it to fit if necessary. Make the bracket rigid and mount it to your engine rather than another surface to prevent erratic operation due to flexing and/or movement.

Position the Throttle Control so the connecting cable is in line with the accelerator rod and pulls in the same direction.

C. Pressure Connection to Pump Discharge Line

Use a 1/4" minimum sized high pressure tube or hose.

Make the connection at the control valve inlet rather than the pump discharge so it will sense the lowest pressure. The pressure will then change by a smaller amount when the oil viscosity changes. The spring tension will also become more effective.

For cold climates, consider whether you need to add a heater to your reservoir and/or shut off valve in this pressure connection to prevent high speed operation of your hydraulic components with cold oil. An oil temperature sensing switch would make them automatic.

D. Engine Throttle Linkage Check

Start the engine. Engage PTO to load the idling engine with by-passing oil pressure. Try to reduce the engine throttle pull to a minimum. Make sure it is well oiled and in good repair. Check with the engine manufacturer whether the return spring load can be reduced if it appears to be excessive for its application.

When the engine has warmed up, make sure it is capable of returning to its proper idle speed after operating the accelerator. Make necessary adjustments now before the connecting cable is applied.

E. Cable Slack Adjustment

Refer to the sketch on page 2. Make sure the actuating rod (9) is still located in hole 4 as shipped.

Secure the clamp (11) to the throttle rod. Engage the cable (10) eyelet to one of the clamp studs. Thread the cable through the hole in the rod, remove almost all slack, and secure it with the set screws.

Finalize the cable slack adjustment with the nuts provided on the actuating rod (9). The cable should have some slack but not excessive. Check to make sure the engine returns to idle after operating the accelerator.

F. Adjusting Procedure

The spring rate is adjustable by moving the fulcrum screw (5) and changing the number of leaf springs (8). See table below for the possible variations. The spring rate increases as the variation number decreases. For instance, the table indicates the spring will be three (3) times stiffer with variation No. 2 than No. 3.

Variation Number	No. of Springs	Fulcrum Hole	Spring Tension			Actuating Rod Hole Location
			*Turns	*Pressure	Rate	
1	3	A	3	1100	11X	4
2	3	B	3	780	3X	4
3	3	C	2-1/2	640	Normal	4
4	2	C	2	370	3/4X	4
5	2	D	5/8	300	1/4X	4

* Note: Apply turns from when the screw (4) just begins to deflect the spring at zero load. Pressure is approximate when piston will begin to move.

The control was shipped with variation 3. Try it first. The adjusting procedure will direct you to another variation, if another is needed.

1. Disengage PTO. Turn in speed screw (7) until it touches spring (8). Then turn out one turn, temporarily, to limit stroke and prevent accidental racing of engine.
2. Engage PTO. Air bleed sensing line by cracking fitting at Throttle Control. Proceed after oil warms up to within normal operating temperature range.
3. Operate a highly loaded circuit valve lever. Bottom out a cylinder to obtain system relief valve pressure if this is easier. The throttle will open.
4. Make speed adjustment. Turn speed screw (7) in or out with the circuit loaded. Use the nut (3) to lock it when it regulates your desired speed. Move actuating rod from hole 4 to hole 3, only if the spring should stop on the housing instead of the screw.
5. Return lever to neutral. The throttle must close and the engine must return to idle. Check Trouble Shooting section, Part II, Section C. If unsuccessful, increase the spring rate, see table above. Repeat entire procedure.

F. Adjusting Procedure (Continued)

6. Determine which of the circuits produce the lowest pressure. Operate it and decide which of the following applies, paragraph 6a, 6b, or 6c.

a. Throttle Opens and Closes Properly From Idle

- (1) Finalize engine speed screw (7) adjustment by alternately operating the lowest and the highest loaded circuits. Lock nut (3) securely.
- (2) Operate and check all other circuits. They should operate because they are loaded between the highest and lowest circuits used for adjustments.
- (3) Installation is now complete.

b. Throttle Does Not Open From Idle Speed, but Will at Higher Speed

Check if it will open at higher engine speeds.

- (1) Operate a higher pressure circuit lever to open the throttle and bring the engine up to speed, then operate the lowest pressure circuit lever.
- (2) If it stays open, after the higher pressure lever is returned, decide whether the required sequence of operation is acceptable. It usually is acceptable. It now contains the highest spring setting.
- (3) If not acceptable, or if it did not stay open, proceed with step (c) below.

c. Throttle Will Not Open at All

Make spring tension adjustment. Proceed as follows:

- (1) Disengage PTO. Turn out screw (4) until leaf spring (8) is loose. Then turn it in until the spring just begins to deflect and is at zero load.
- (2) Engage PTO. The throttle will open.
- (3) Turn screw (4) in gradually. Count turns, and record as "B", until the throttle just closes. Do not overshoot and leave the screw at this point. Note how the throttle closed. If it closed suddenly, increase the spring rate, see table above. Repeat adjustment from paragraph c (1).

6c. (Continued)

- (4) Operate the lowest pressure circuit. The throttle must open. If it opened, proceed directly to step 5. Otherwise, choose between (a) and (b) below.
 - (a) If it did not open, the motivating force is below zero. Revise the plumbing to increase the amount the pressure will increase when the circuit is operated. See Section A.
 - (b) Operate the next higher loaded circuit, etc. until you find a circuit that does operate from idle. Use this circuit for the adjustments specified in paragraph 5 below. You will find out later whether the lower pressure circuits, that did not operate from idle, will become operable at a higher speed.
- (5) Turn in on screw (4) in small increments equal to approximately 10% of the total turns given in the table above.

After each increment, operate the lowest pressure circuit lever from neutral to fully open the throttle, and then return it to neutral to fully close the throttle.

Wait for the engine to idle before repeating.

Count, and record as "C", the number of turns to exactly when the throttle no longer opens from idle.

Note: Increase the spring rate, see table above, if the total turns counted (B plus C), exceeds by more than 20% the number of turns noted in the table above.

Decrease your spring rate if you observed the throttle will no longer fully open.

Repeat adjustment from paragraph c(1), if spring rate was changed.

- (6) Turn screw (4) out $1/8$ turn or $1/4$ times "C" turns whichever is greater to provide an operating margin between the lowest circuit pressure and the final spring tension.
- (7) Check operation as per paragraph F6a or F6b. If the lighter loaded circuits do not operate, revise the plumbing to increase the amount the pressure will increase when these circuits are operated. See Section A.

II. TROUBLE SHOOTING HINTS

A. Problem: Engine Does Not Idle But Speeds Up When PTO Is Engaged

<u>Probable Cause</u>	<u>Remedy</u>
1. Control lever stuck open.	1. Return all valves to neutral.
2. Low leaf spring tension.	2. Repeat calibration.
3. Cold Oil.	3. Warm oil. Also check Part I, Section "C".

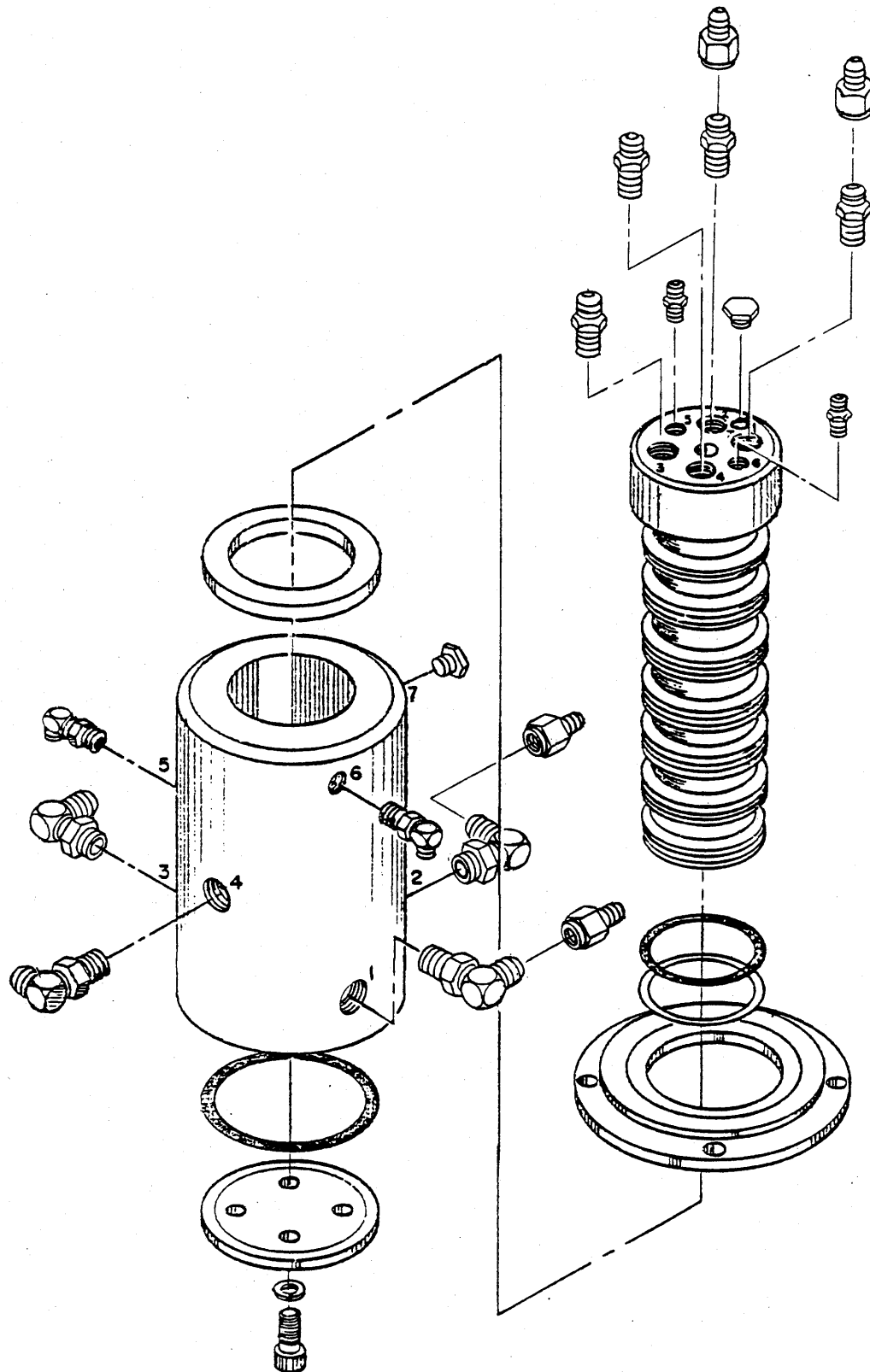
B. Problem: Engine Does Not Speed Up When Light Load Is Applied

<u>Probable Cause</u>	<u>Remedy</u>
1. PTO not engaged.	1. Engage PTO.
2. Air in sensing line.	2. Bleed line. Crack fitting at control.
3. Connecting cable.	3. Reduce slack to minimum.
4. Stops on speed screw.	4. Adjust screw.
5. Hot oil.	5. Allow oil to cool.
6. Your engine throttle linkage.	6. Oil and repair. Check manufacturer for lighter spring if it is excessive.
7. Circuit pressure is too low.	7. Revise plumbing to increase spread between your circuit and by-passing pressures. See Part I, Section "A".
8. Excessive leaf spring tension.	8. Repeat calibration.
9. Excessive leaf spring rate.	9. Reduce spring rate. See table in Part I, Section "F".

C. Problem: Engine Does Not Return To Idle After A Load Is Applied

<u>Probable Cause</u>	<u>Remedy</u>
1. Engine speed excessive.	1. Reset speed screw adjustment.
2. Your engine.	2. Make sure it can idle.
3. Connecting cable.	3. Check for slack.
4. Low leaf spring rate.	4. Increase spring rate. See table in Part I, Section "F".
5. Low leaf spring rate.	5. Repeat calibration.
6. Excessive by-passing pressure.	6. Remove "bottlenecks" or increase line size downstream of the control connection.

ROTARY COUPLING



INSTALLATION PROCEDURE FOR TEFLON RINGS

EQUIPMENT NEEDED:

1. Heating container (NESCO oven or equivalent).
2. One (1) pair of heat resistant gloves.

OPERATION:

1. Insure coupling is free of foreign matter.
2. Place teflon rings in oven until 300°-350° is reached. **CAUTION--**
Do not exceed 500°. (Rings should turn dark in color and become elastic.)
3. Grasp a ring (using gloves) and slip over end of coupling to groove. **CAUTION---** Do not stretch rings as they will not return to size.
Speed is essential before contracting occurs.
4. Insure ring is not twisted when installed in groove.

NOTE:

Rings that are loose on coupling can be sized by compressing with suitable hose clamp.

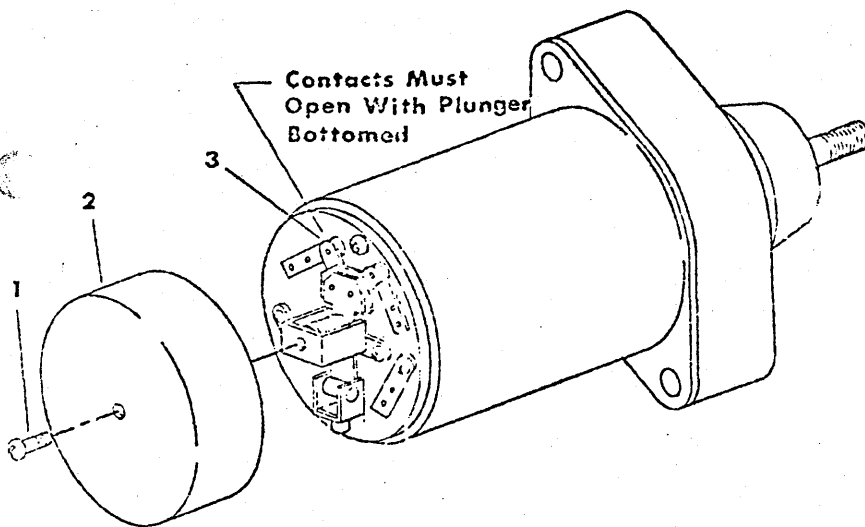
SYNCHRO-START D.C. SOLENOIDS

GENERAL INFORMATION

Because of the dual coil design, Synchro-Start D.C. Solenoids may be energized continuously without any duty cycle derating. This is an advantage over single coil solenoids. The dual coils, one low resistance, the other high resistance, permit safe operation even in high ambient temperatures.

The low resistance coil provides a high pulling force. Upon completion of the plunger stroke, the heavy duty double break self contained switch automatically disconnects the high current pull winding within .040 seconds of energization. This means that Synchro-Start D.C. Solenoids pack more power in a smaller space at lower cost.

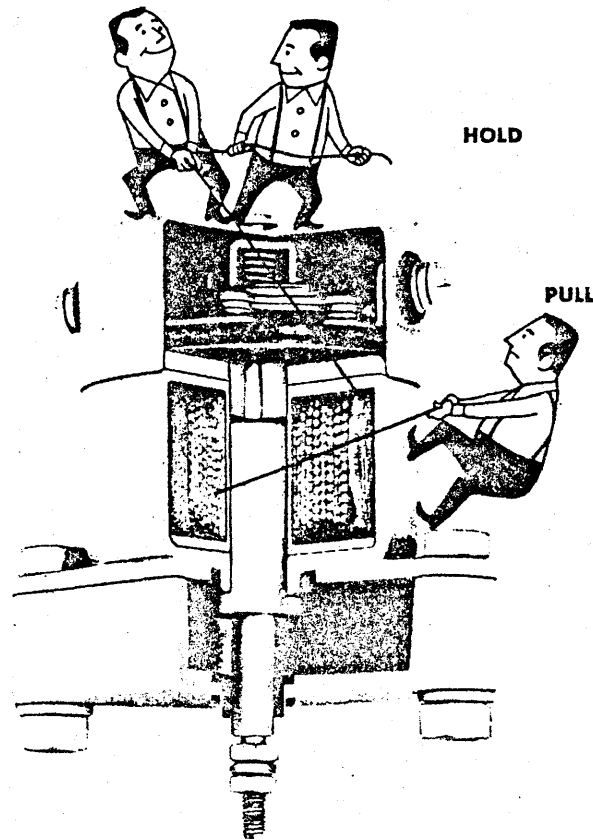
All D.C. solenoids using dual coils must be installed and adjusted so that the plunger always completes its stroke, i.e., the plunger must bottom, disconnecting the *low resistance coil*. If this does not occur, *excessive heat* ensues, which in time (over 30 sec.), does irreparable damage.



WARRANTY

Proper installation is extremely important. Plunger must bottom properly to operate pull coil disconnect switch. If contacts fail to open and circuit is not protected against overload, the pull coil will burn out in 50 seconds. Damage of this type is due to faulty installation and is not covered by Synchro-Start's normal warranty.

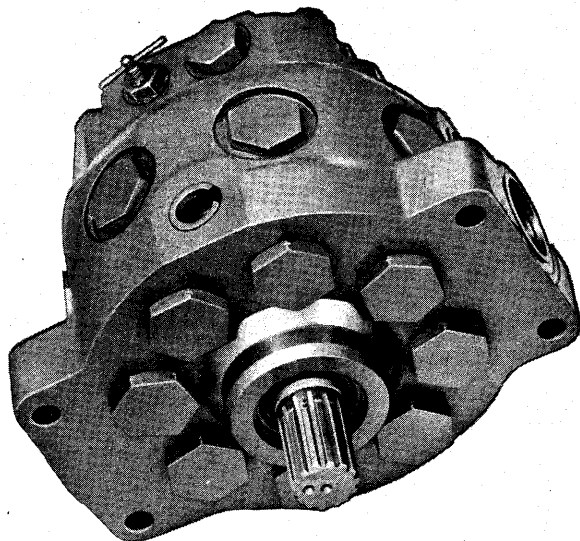
THE DUAL COIL GIVES GREATER PULLING POWER AND PERMITS CONTINUOUS OPERATION AT HIGHER AMBIENT TEMPERATURES



Synchro-Start Heavy Duty Solenoids are Rugged and Performance Tested.



PR24, PR30, PR40 HYDRAULIC PUMPS



GENERAL DESCRIPTION

Type Radial piston
Displacement 2.4, 3.0, and 4.0 cu. in./rev.
Approximate weight 60 lb.

FEATURES

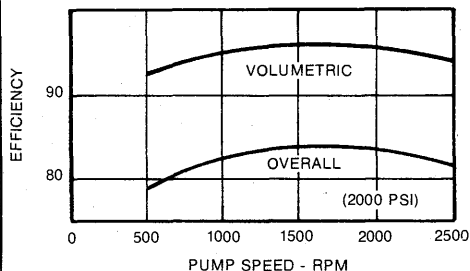
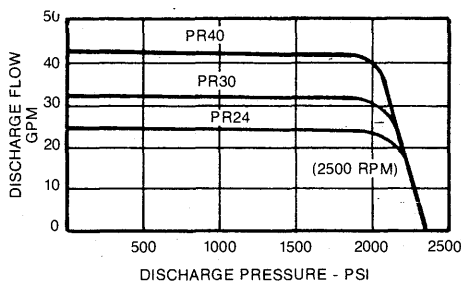
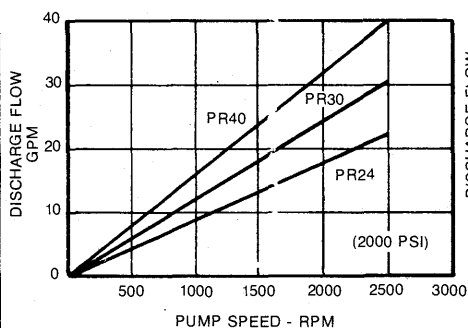
Variable displacement
Pressure-compensated discharge
Rapid response
High power-to-weight ratio
High volumetric and overall efficiency
Exceptional reliability
Low cost

Three sizes, 2.40-, 3.00-, and 4.00-cu.-in./rev., with various shut-off-control and port-size options are available. Deactivation permits torque reduction as a starting aid. All ports are straight-thread O-ring openings (SAE J514d). The pumps are provided with either two or three inlet ports which may be used in various combinations.

PERFORMANCE

The discharge characteristics of the pumps are nearly constant over a broad pressure range. Variable displacement is accomplished by hydraulic rather than mechanical means and is responsive to discharge line pressure. Discharge is infinitely variable between the point of inflection on the constant-discharge portion of the curve and zero flow.

With their rapid response characteristics, these pumps perform exceptionally well as the power source for closed-center systems, as well as for open-center systems.



Adjacent Curves:
Average performance
at 190° F (87.8° C)
inlet temperature,
25 psi [1.76 Kg/cm²]
charge pressure,
using SAE 10W20

SPECIFICATIONS:

(Specifications and design subject to change without notice.)

Pump Series	Displacement Cu-In/Rev	Discharge Flow—GPM			Displacement Control	Ports	Shut-Off Control	Shut-Off Option Available
		1200 RPM	1800 RPM	2500 RPM				
PR24	2.4 (39,3cm ³)	11.2	16.7	23.3	Variable	B	Optional	Manual
PR30	3.0 (49,2cm ³)	14.5	21.8	30.2	Variable	B	Optional	Manual, Electric
*PR40	4.0 (65,5cm ³)	19.0	28.5	39.5	Variable	E	Optional	Manual, Electric

JDT 841 (SAE J514d) "O" Ring Port Sizes				
Code	Discharge		Inlet	
	A1	B1	B2	C1
A	7/8-14	1-1/16-12		7/8-14
B	7/8-14	1-1/16-12	1-5/8-12	7/8-14
E	1-1/16-12	1-5/16-12	1-5/8-12	7/8-14

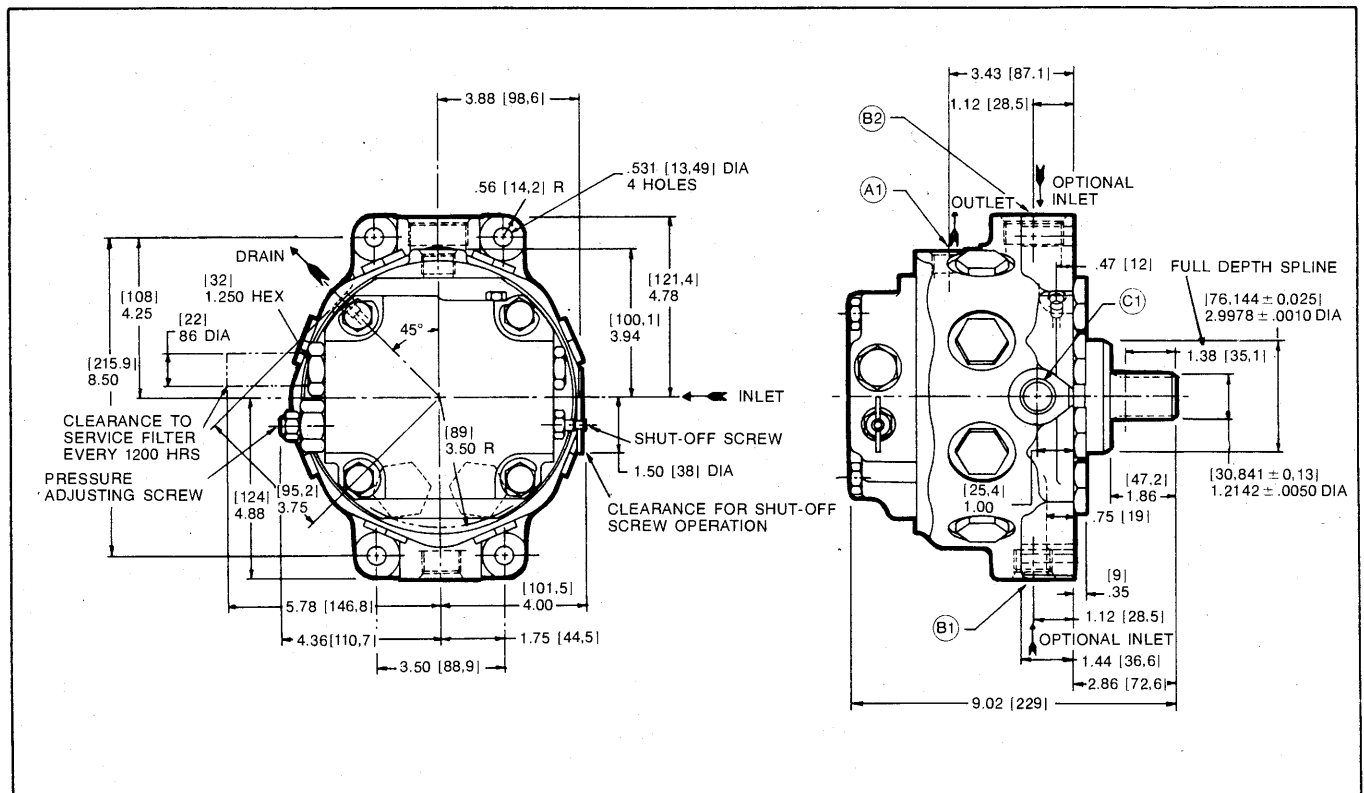
Max. Pressure at Max. flow—2000 PSI

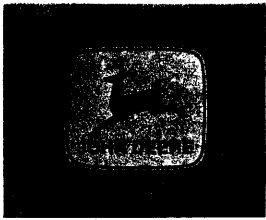
Max. Zero Flow Pressure—2400 PSI

Max. Speed—2500 RPM (Loaded); 2650 RPM (Zero Flow)

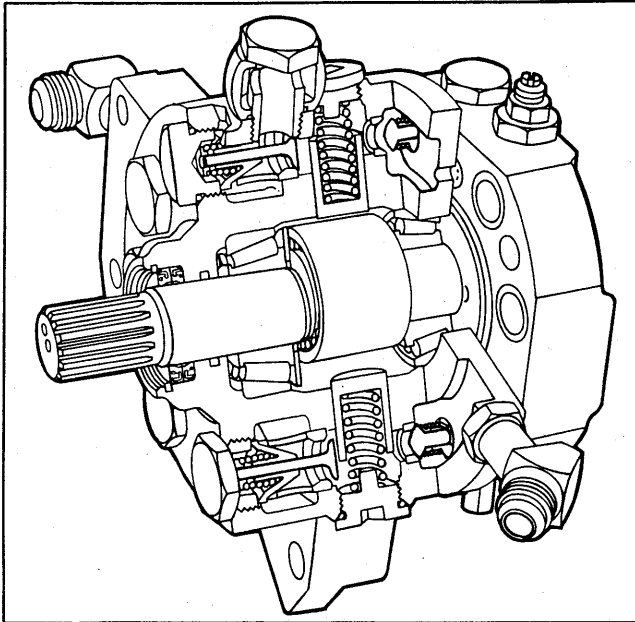
*Requires AR 46054 Accumulator in Discharge Line

SHAFT SPLINE DATA	
NUMBER OF TEETH	14
PITCH DIAMETER	1.1667 [29,634]
CIRCULAR TOOTH THICKNESS AT PD	MAX. EFFECTIVE .1309 [3,325] W/RELATION GAGE MIN. ACTUAL .1251 [3,178]
PRESSURE ANGLE	30°
MINOR DIAMETER	1.0400 [26,416]
MAJOR DIAMETER	1.25 - 1.225 [31,75 - 31,12]





PR24,30,40 and 60 Series Hydraulic Pumps Technical Manual



OPERATION

The pump shaft (4, Figure 1) has a cam (3) machined as an integral part of the shaft. A race (2) mounted on needle bearings is positioned around the cam for actuating the eight pistons (9) located radially around the race.

The crankcase area (1) of the pump in which the pump shaft, cam, and race are located contains oil under pressure to hold the pistons away from the race. The pistons are held in this "standby" position until a demand for oil is placed on the pump by the operation of one or more of the hydraulic functions.

All eight pistons are connected together by two separate annular passages which serve as inlet (7) and outlet (12) galleries for the pistons. Each piston is connected to the annular passages by individual inlet (6) and discharge (11) valves.

Operation of one or more of the hydraulic functions reduces pressure in the outlet gallery of the pump and crankcase outlet valve (15) assembly. This pressure reduction causes the crankcase outlet valve spring (16) to move the valve up, permitting oil from the pump crankcase to enter the inlet gallery of the pump. Reducing oil pressure in the pump crankcase permits the spring loaded pistons (9) to move toward the race.

As the pistons move toward the race a partial vacuum is created at the outer or spring end of the pistons. This partial vacuum plus inlet oil pressure, opens the inlet valves (6) of the pistons, allowing oil to enter and fill the spring area of the pistons. At the end of the intake stroke, the partial vacuum no longer exists and the inlet valve spring closes the inlet valve against the inlet oil pressure.

Further rotation of the pump shaft, cam, and race causes the pistons to move out, forcing the trapped oil through the discharge valve (11) into the outlet gallery. At the end of the pressure stroke the discharge valve spring (10) closes the discharge valve. This sequence of operation continues until the combined effort of all the pistons increases oil pressure in the outlet gallery. This increased pressure also takes place in the center and upper area of the crankcase outlet valve (15). The upper part of the valve is larger than the bottom, giving the increased pressure oil more surface to work against. This forces the valve down, overcoming resistance of the crankcase outlet valve spring. The valve moving down stops oil flow from the pump crankcase to the inlet gallery of the pump.

The increased pressure oil in the upper area of the crankcase outlet valve enters the stroke control valve (13) assembly, forcing the stroke control valve open. This allows pressure oil to enter the pump crankcase, increasing crankcase pressure. The race moves the pistons out and the increased crankcase pressure holds the pistons away from the race in "standby" position.

The stroke control valve (13) can be adjusted to give more or less pressure in the outlet gallery and pump crankcase. By controlling oil pressure in the pump crankcase, the amount the piston springs move each piston toward the race can be controlled, thereby controlling the stroke.

Any oil leakage past the pistons and stroke control valve re-enters the inlet gallery of the pump. This is accomplished by a 0.060-inch bleed hole (14) from the area below the stroke control valve to the inlet gallery of the pump. This oil circulation also provides cooling for the pump.

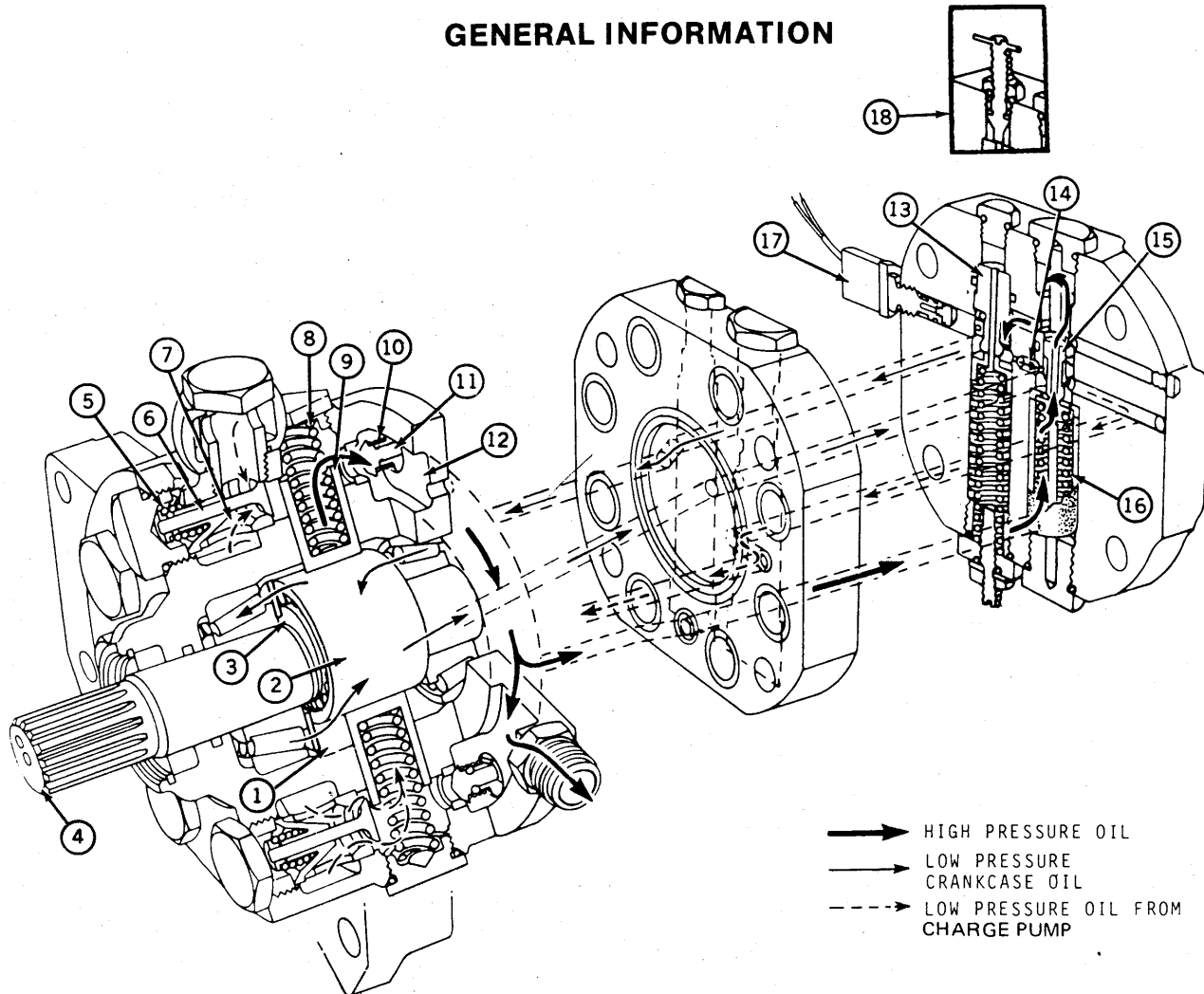
GENERAL INFORMATION

Fig. 1—Oil Flow Through Hydraulic Pump

DIAGNOSING PUMP MALFUNCTIONS

No Pump Output

Pump out of stroke.

- Check pump shutoff screw.
- Reset pump stroke control valve.
- Stroke control valve stuck open.
- Pump shaft broken.

Erratic Pump Operation

Stroke control valve not seating properly.
Check for foreign material or damaged seat.

Leaking inlet or discharge valve, defective O-rings.
Replace inlet and discharge valve; replace O-rings in stroke control valve housing.

Piston springs not balanced.
Check for broken springs or springs at unequal tension.

Pump piston sticking in bore.
Clean pump and check for damaged piston.

Pump Noise Or Squeal

Stroke control valve spring guide binding.
Dress down sharp bottom edge. Reset system pressure.

Loose drive coupling cap screws.
Tighten to specified torque.

Air trapped in stroke control valve oil cavity.
Relieve tension on stroke control valve adjusting screw, bleed air through threads, and reset system pressure.

Pump Slow Going Out of Stroke

Wear at quad ring seal groove causes crankcase oil leakage.
Replace pump housing and seal.

Standby Pressure Does Not Remain Constant

Stroke control valve piston sticking in bore.
Replace piston or remove burrs with fine crocus cloth.

Disassembly

Before disassembling pump, check shaft for end play. Steel shims are located in the stroke control valve housing for making this adjustment. End play should be from 0.002 to 0.006 in. Excessive shaft end play may be an indication of worn thrust washers.

Disassemble pump as follows:

1. Remove stroke control valve housing. (Note the number of adjusting shims.) Remove discharge valve guides and valve springs (Fig. 6) and, using a magnetic pick up tool, remove discharge valves.

Keep pistons, inlet valves, discharge valves and plugs sorted so they may be returned to their original positions. Pump parts tray JDH-21 can be used for this purpose.

2. Remove piston plugs and O-rings (Fig. 6); pull piston springs and pistons from housing.

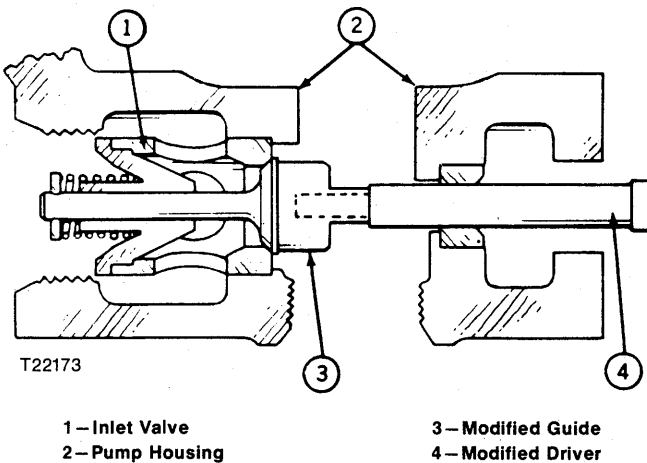


Fig. 5—Driving Out Inlet Valve Assembly

3. Drive inlet valve assemblies from housing with tool made from old R27157 Discharge Valve Guide (with chamfer ground off) and a driver with shoulder ground to fit guide (Fig. 5) (see Special Tools).

4. Drive discharge valve seats from the housing with JDE-54 Tool (see Special Tools).

After discharge valve seats have been removed, drive out pump shaft assembly while supporting machined surface of pump housing on wooden blocks.

5. Remove pump shaft bearing race from the end opposite splined end of pump shaft. Then remove needle bearing from around pump shaft cam and press bearing off splined end of shaft.

6. Remove crankcase outlet valve and stroke control valve assemblies from stroke control valve housing.

7. Remove pump shut-off screw and crankcase outlet valve adjusting plug from the stroke control valve housing.

Inspection

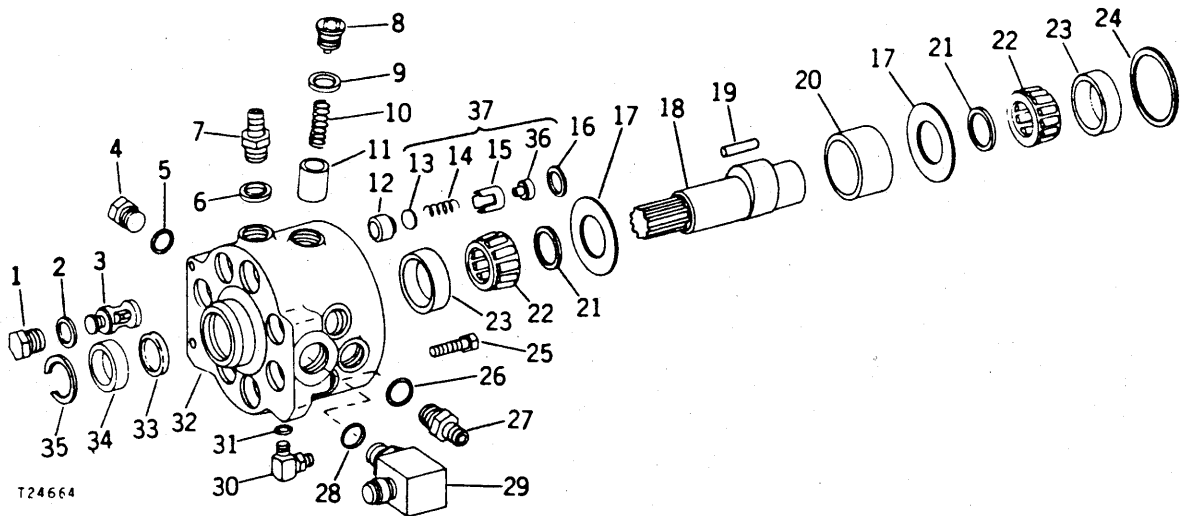
See Specifications and compare pump parts with dimensions given. Check all parts for excessive wear, scored or pitted surfaces, or other damage.

Check for looseness of inlet valve stem in valve guide. This fit should be tight.

When roller bearings have been removed from pump shaft, always use new thrust washers.

Inspect stroke control valve and crankcase outlet valve for foreign material or varnish buildup. Remove varnish build-up with crocus cloth. Never use lapping compound to remove varnish.

Thoroughly clean filter screen below the crankcase outlet valve.



- | | | |
|----------------------------------|-----------------------------|--------------------------------------|
| 1—Plug (8 used) | 14—Spring (8 used) | 26—O-Ring |
| 2—O-Ring (8 used) | 15—Guide (8 used) | 27—Connector |
| 3—Inlet Valve (8 used) | 16—Packing (8 used) | 28—O-Ring |
| 4—Plug | 17—Thrust Washer (2 used) | 29—Elbow |
| 5—O-Ring | 18—Pump Shaft | 30—Elbow |
| 6—Sealing Washer | 19—Roller Bearing (36 used) | 31—O-Ring |
| 7—Hose Connector | 20—Race | 32—Housing |
| 8—Piston Plug (8 used) | 21—Spacer (2 used) | 33—Quad-Ring Packing |
| 9—O-Ring (8 used) | 22—Cone (2 used) | 34—Oil Seal |
| 10—Spring (8 used) | 23—Bearing Cup (2 used) | 35—Snap Ring |
| 11—Piston (8 used) | 24—Shim | 36—Discharge Valve Stop (8 used) |
| 12—Discharge Valve Seat (8 used) | 25—Cap Screw (4 used) | 37—Discharge Valve Assembly (8 used) |
| 13—Discharge Valve (8 used) | | |

Fig. 6 — Assembly View

Assembly

NOTE: Always install new O-rings, packings, and oil seals. Use overhaul kit available (see parts catalogue). Dip all parts in clean Type 303 Special-Purpose Oil before assembly.

Install pump shaft bearing race in housing bore until it seats.

Place pump shaft O-ring in housing, coat sealing lips of pump shaft oil seal with lubriplate and install seal (lettered side out) using JDH-18 driver (see Special Tools). Drive in seal only far enough to allow snap ring to snap in place. If oil seal is installed beyond snap ring groove, the oil relief outlet will be restricted and oil seal failure will result.

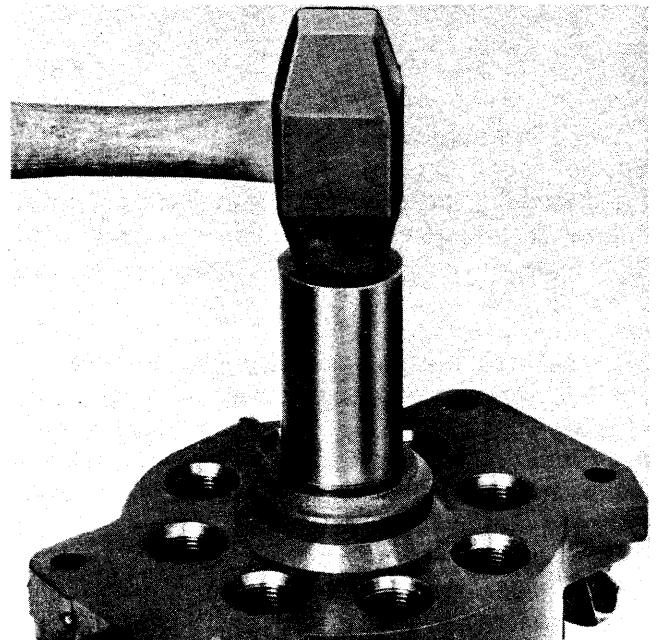


Fig. 7 — Installing Oil Seal and Snap Ring

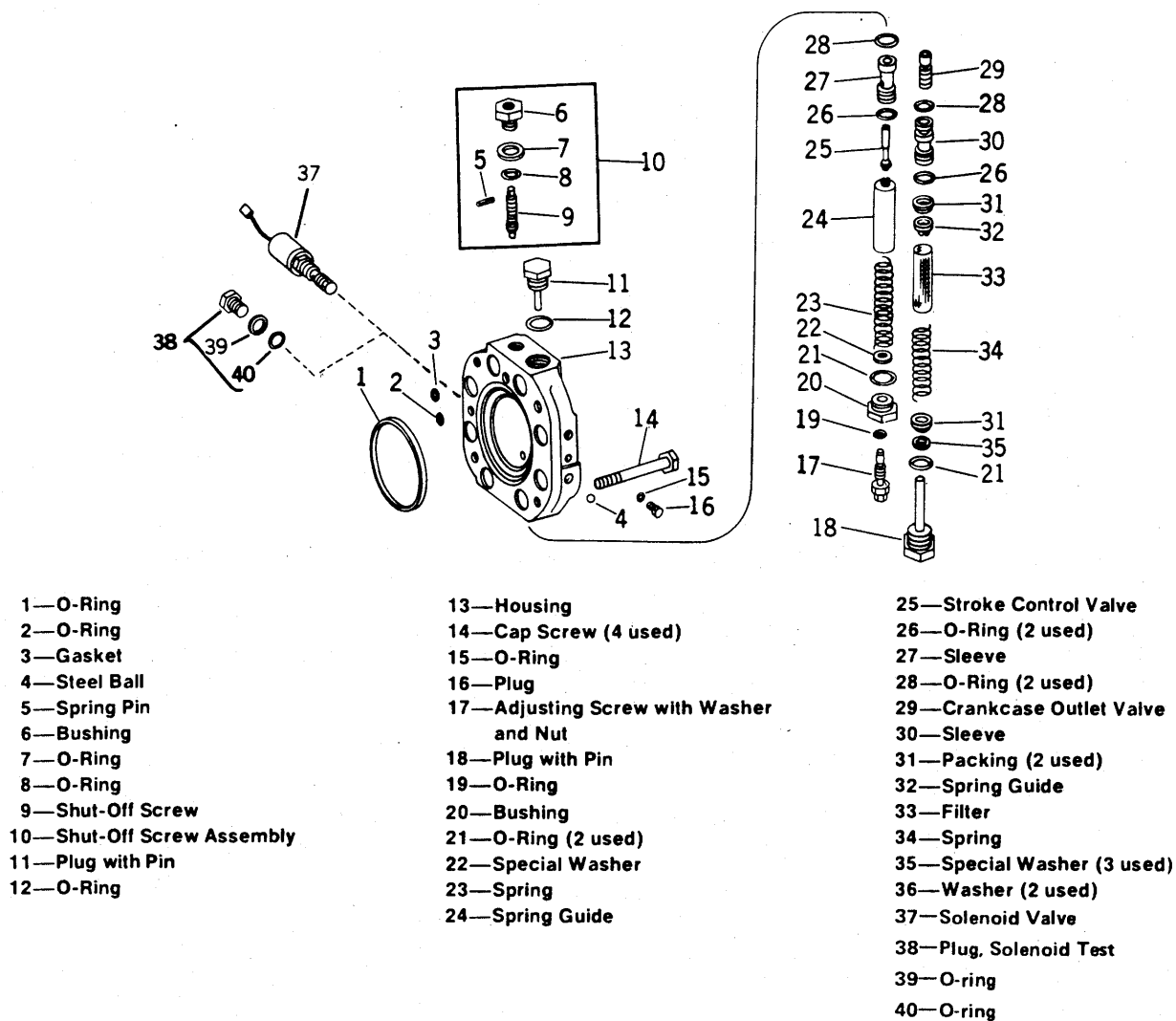


Fig. 8 — Stroke Control Valve

Using Discharge Valve Seat Installation Tool (see Special Tools), drive on shoulder of seats with no more than 850 lbs. of force until they are bottomed in bore. Distance from pump housing surface to the discharge valve seat shoulder must be at least 0.870 in.

Install thrust washer and bearing spacer on pump shaft. Press tapered roller bearing on splined end of shaft. Turn shaft over, place needle bearing race over pump shaft cam, and insert needle bearings. Install thrust washer and other bearing spacer. Press on tapered roller bearing.

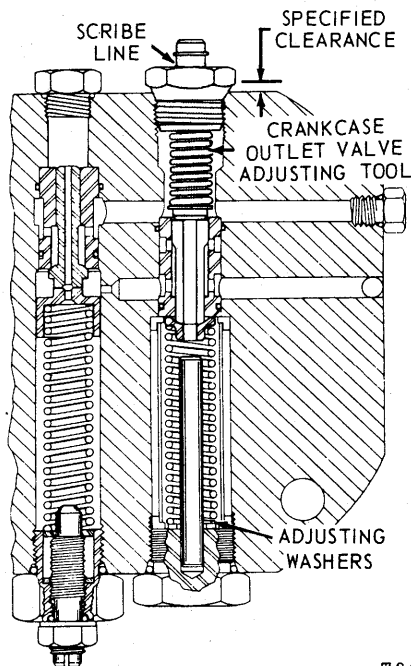
Install assembled pump shaft in housing carefully so as not to damage oil seal. Install bearing and bearing race in pump housing.

Install inlet valve assemblies in pump housing and replace inlet valve plugs. Tightening the plugs will press inlet valves into place.

Install pistons, springs, and piston plugs. Apply Loctite to plugs and tighten to 100 ft-lbs. For easier assembly, turn pump shaft until the piston assembly being installed is on the low part of the cam.

Assemble and install stroke control and crankcase outlet valves in stroke control valve housing.

Use Fig. 4, page 60-10-5 as reference in assembling zero/max flow pump stroke control valve.



- | | |
|-----------------------|---------------------|
| 1—Scribe Line | 3—Adjusting Tool |
| 2—Specified Clearance | 4—Adjusting Washers |

Fig. 9 — Cutaway of Stroke Control Housing
with JDH-19 Tool Installed

NOTE: Test JDH-19 Tool before using it to adjust crankcase outlet valve. Scribe line on plunger must align with top of plug when $35 \pm 1/2$ lbs. of force is applied. Add or remove shims (No. 10815 and/or No. 10816*) to obtain correct adjustment. If desired, standard SAE 1/4 in. steel washers (1/4" x 7/16" x 3/64") may be used instead of shims.

Adjust crankcase outlet valve using tool JDH-19. Install tool in housing leaving 1/8 in. clearance between flat surface of nut and housing (Fig. 9). Add adjusting washers as indicated. When the valve is adjusted properly, the scribe line will be flush with top of nut on the tool. This procedure is not used when assembling zero/max flow pump.

Before installing discharge valves, springs, and guides, place stroke control valve housing, with adjusting shims, on pump housing. Tighten cap screws to 85 ft-lbs. Check pump shaft for end play. Add or deduct adjusting shims in the stroke control valve housing to obtain 0.0020 to 0.0060 in. end play.

After correct end play has been determined, remove stroke control valve housing. Install discharge valves, springs, and guides in main pump housing. Replace packings in stroke control valve housing and install control valve housing, using 85 ft-lbs on each cap screw.

Add oil to seal cavity through bleed line connector to provide initial lubrication for shaft seal.

SPECIFICATIONS

Pump Series	24, 30 and 60	40
I.D. of housing at pump shaft O-ring	1.3850 to 1.3870 in.	
I.D. of housing at pump shaft oil seal	2.0110 to 2.0210 in.	
I.D. bearing bores for pump shaft	3.3745 to 3.3755 in.	
I.D. of piston bore	0.8747 to 0.8753 in.	0.9637 to 0.9643
O.D. of piston	0.8740 to 0.8744 in.	0.9630 to 0.9634
I.D. of inlet valve bore	0.9995 to 1.0005 in.	
O.D. of inlet valve assembly	1.0010 to 1.0020 in.	
Lift of inlet valve	0.0600 to 0.0820 in.	
I.D. of discharge valve bore	0.6245 to 0.6255 in.	
O.D. of pump shaft cam	1.9632 to 1.9638 in.	1.7442 to 1.7448
I.D. of cam race	2.3400 to 2.3406 in.	2.2457 to 2.2465
O.D. of cam race	2.8700 to 2.8800 in.	2.8140 to 2.8160
Thickness of drive shaft thrust washer	0.1230 to 0.1270 in.	0.0422 to 0.0452
Stroke control valve housing, flat within	0.0030 in.	
I.D. of stroke control valve bore in housing	0.7485 to 0.7495 in.	
O.D. of stroke control valve	0.2661 to 0.2665 in.	
I.D. of stroke control valve sleeve, lower section	0.3756 to 0.3762 in.	
O.D. of stroke control valve sleeve	0.7481 to 0.7485 in.	
O.D. of crankcase outlet valve, upper end	0.4368 to 0.4372 in.	
O.D. of crankcase outlet valve, lower end	0.4678 to 0.4682 in.	
I.D. of crankcase outlet valve sleeve, upper end	0.4374 to 0.4380 in.	
I.D. of crankcase outlet valve sleeve, lower end	0.4684 to 0.4690 in.	
O.D. of crankcase outlet valve sleeve	0.7481 to 0.7485 in.	
I.D. of crankcase outlet valve bore in housing	0.7485 to 0.7495 in.	
Discharge valve spring free length	1/2 in.	
test strength	1-1/2 pounds at 5/32	
Clearance between flat surface of nut on Tool JDH-19 and pump housing	1/8 (0.125) in.	
Pump shaft end play	0.0020 to 0.0060 in.	
Thickness of adjusting shim, stroke control housing	0.0060 to 0.0100 in.	
Standby hydraulic pressure	2200 to 2300 psi	

Piston Springs

Compressed to	1 $\frac{5}{8}$ in.	1 $\frac{3}{4}$ in.
Color code—yellow	34.0 to 35.5 lbs.	47.0 to 48.5 lbs.
green	35.5 to 37.0 lbs.	48.5 to 50.0 lbs.
blue	37.0 to 38.5 lbs.	50.0 to 51.5 lbs.
red	38.5 to 40.0 lbs.	51.5 to 53.0 lbs.

TORQUE VALUES

Item	Torque (ft-lbs.)	
	0.69 and 1.38 cu. in.	3.01 cu. in.
Pump piston plugs	100	100
Pump cover to body cap screws	36	...
Pump drive special screws to crankshaft pulley	35	35
Pump drive special screws to pump drive shaft	20	35
Pump to pump support	85	85
Pump drive shaft retaining screw(s)	32	32
Pump drive coupler cap screws	25	25
Coupler screw locknuts	25	...
Stroke control housing to main pump cap screws .....	...	85

SPECIAL TOOLS

No.	Name	Use
Essential Tools		
JDH-18*	Driver	To install oil seal
JDH-19*	Crankcase outlet valve adjusting tool	To adjust crankcase outlet valve
JDE-54*	Driver	Remove discharge valve seat
Time Saving Tools		
JDH-21*	Pump parts tray	Contain parts during disassembly
Fig. 12**	Installation tool	Install discharge valve seat
Fig. 13**	Removal tool	Remove inlet valve assembly

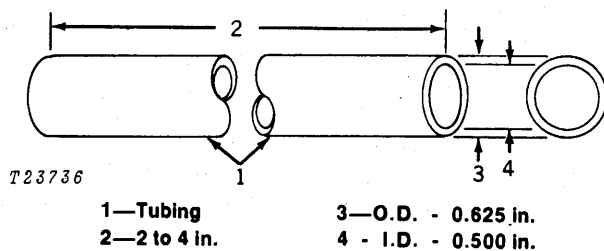


Fig. 12-Discharge Valve Seat Installation Tool

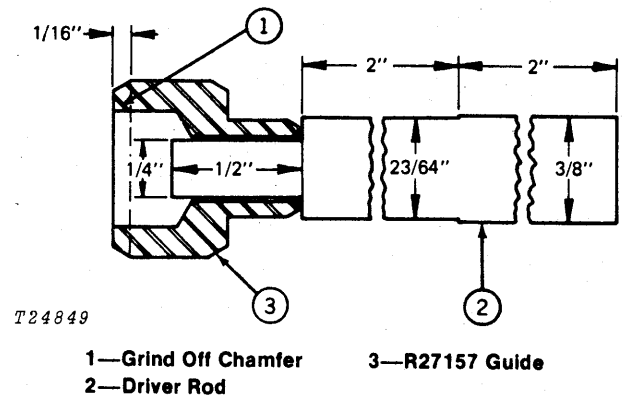
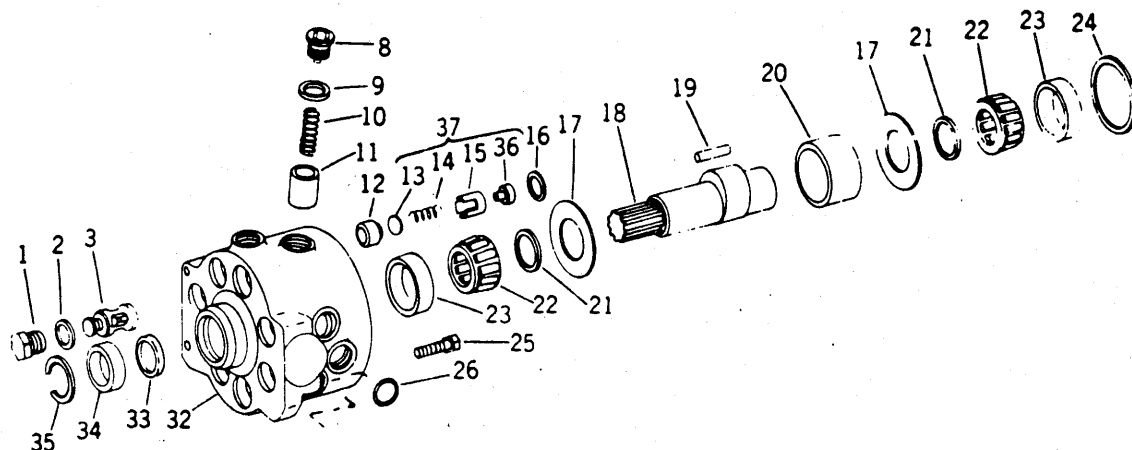


Fig. 13-Inlet Valve Removal Tool

*Order from Service Tools Inc., 1901 Indiana Ave., Chicago, Ill. 60616.

**Make in dealer's shop.

HYDRAULIC PUMP (2.41 Cubic Inch)



T 20311

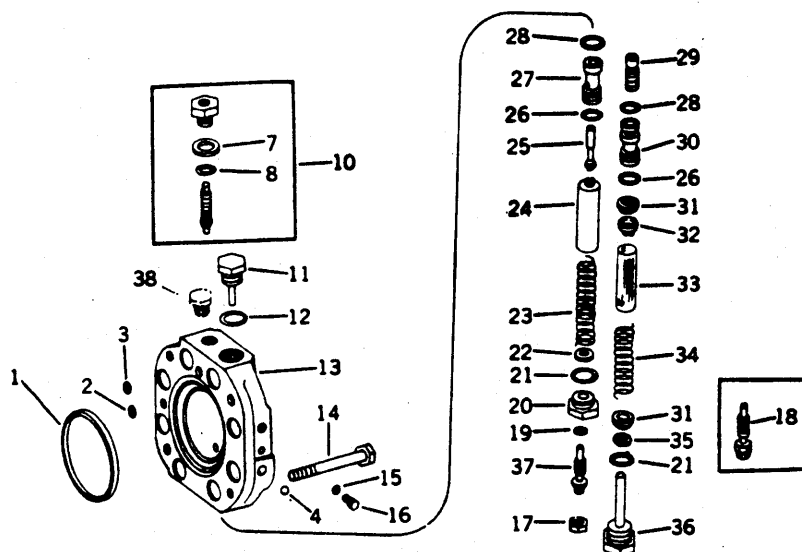
Key	Part No.	Model or Serial No.	Description
1	R 51912	(-)	Plug (8 used)
2	R 27149 *	(-)	O-ring (8 used)
3	HR 53301	(-)	Valve, inlet (8 used)
8	R 45438	(-)	Plug, hydraulic pump piston (8 used)
9	R 495 R*	(-)	O-ring (8 used)
10	AR 55186	(-)	Spring, hydraulic pump piston (8 used) (set of 8 matched)
11	R 27150	(-)	Piston, hydraulic pump (8 used)
12	R 39067	(4PP3 -)	Seat, pump discharge valve (8 used)
13	R 49297	(4PP3 -)	Valve, pump discharge (also order one R49298) (8 used)
14	R 39228	(4PP3 -)	Spring (8 used)
15	R 48738	(4PP3 -)	Guide, pump discharge valve (8 used)
16	R 56754	(-)	Packing, discharge valve guide (8 used)
17	R 42467	(-)	Washer, thrust (2 used)
18	R 39843	(-)	Shaft, hydraulic pump
19	R 27145	(-)	Bearing, roller (36 used)
20	R 45874	(-)	Race
21	R 34349	(-)	Spacer (2 used)
22	JD 8192	(-)	Cone, with rollers (2 used)
23	JD 8223	(-)	Cup, bearing (2 used)
24	R 27478	(-)	Shim, .006" steel (3 used)
	R 27479	(-)	Shim, .010" steel (2 used)
25	19H 1805	(-)	Screw, cap, 1/2" x 2-1/4" (4 used)
26	R 26906 *	(-)	O-ring
32	AR 47580	(4PP3 -)	Housing, pump, with inlet valves, plugs, packings and seats (marked R45228)
33	R 39729 *	(-)	Packing, quad ring
34	AR 52224 *	(-)	Seal, oil
35	R 26137	(-)	Ring, snap
36	R 49298	(4PP3 -)	Stop, outlet valve (also order one R49297) (8 used)
37	AR 52785	(4PP3 -)	Valve, outlet assembly (8 used)

AR 39088 (-) Pump assembly, hydraulic, complete

* Kit listed below contains all parts followed by an asterisk (*)

AR 52223 (-) Kit, overhaul

HYDRAULIC PUMP STROKE CONTROL VALVE (2.41 Cubic Inch Pump)



Key	Part No	Serial No.	Description
1	R 56755	(-)	O-ring
2	R 56756	(-)	O-ring
3	R 56757	(-)	Gasket
4	R 26552	(-)	Ball, 5/16"
7	R 26448	(-)	O-ring
8	R 30903	(-)	O-ring
10	AR 33249	(-)	Screw assembly, pump shut-off
11	AR 51745	(-)	Plug, with pin
12	R 26906 *	(-)	O-ring
13	AR 38714	(-)	Housing (R42663), stroke control valve, with ball
14	19H 1945	(-)	Screw, cap. 1/2" x 3-1/4" (4 used)
15	R 26287 *	(-)	O-ring
16	R 31631	(-)	Plug
17	14H 1021	(-)	Nut, 7/16"
18	AR 51929	(-)	Screw, adjusting, hex head (Optional socket head, use AR 52254 and 14H1021)
19	R 28782 *	(-)	O-ring
20	R 28781	(-)	Bushing, adjusting screw
21	F 3171 R*	(-)	O-ring (2 used)
22	R 48808	(-)	Washer, special
23	R 31781	(-)	Spring
24	R 32344	(-)	Guide, spring
25	R 27472	(-)	Valve, pump stroke control
26	R 27166 *	(-)	O-ring (2 used)
27	R 27471	(-)	Sleeve, pump stroke control valve
28	R 27564 *	(-)	O-ring (2 used)
29	R 27172	(-)	Valve, pump crankcase outlet
30	R 27476	(-)	Sleeve, pump crankcase outlet valve
31	R 27174 *	(-)	Packing (2 used)
32	R 27167	(-)	Guide, spring
33	R 27173	(-)	Filter
34	R 27159	(-)	Spring
35	R 27170	(-)	Washer, special (3 used)
36	24H 1298	(-)	Washer, 3/8" x 5/8" x .030" (2 used)
37	AR 26646	(-)	Plug with pin
38	AR 52254	(-)	Screw, adjusting, socket head (Optional hex head, use AR51929)
	R 27218	(-)	Plug

* Kit listed below contains all parts followed by an asterisk (*)
AR 52223 (-) Kit, overhaul

Bertea Industrial Division
July 1980

Service Manual

Remote Control Proportional Directional Valve Open or Closed Center Circuits Series 225900



SERVICE MANUAL SERIES 225900

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BERTEA PROPORTIONAL CONTROL VALVE
FOR OPEN CENTER CIRCUITS

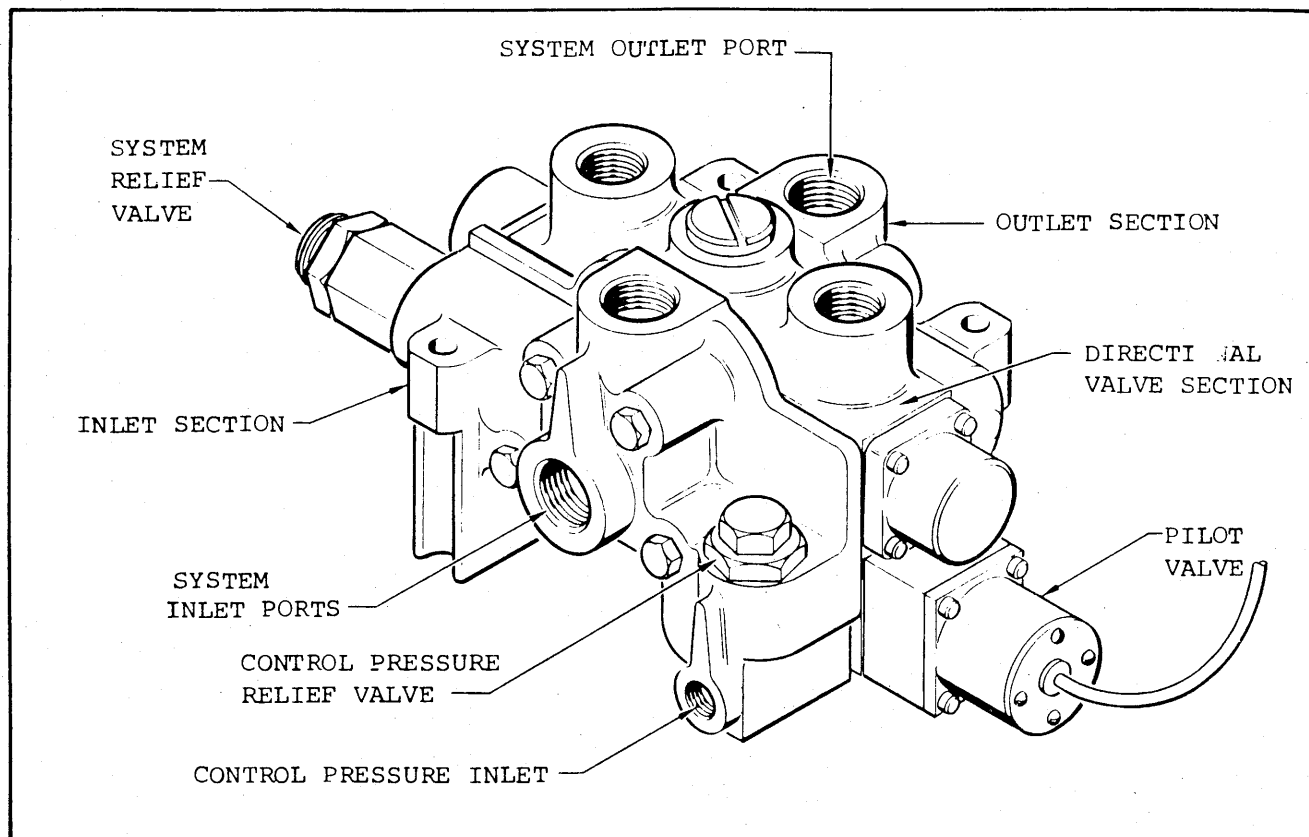
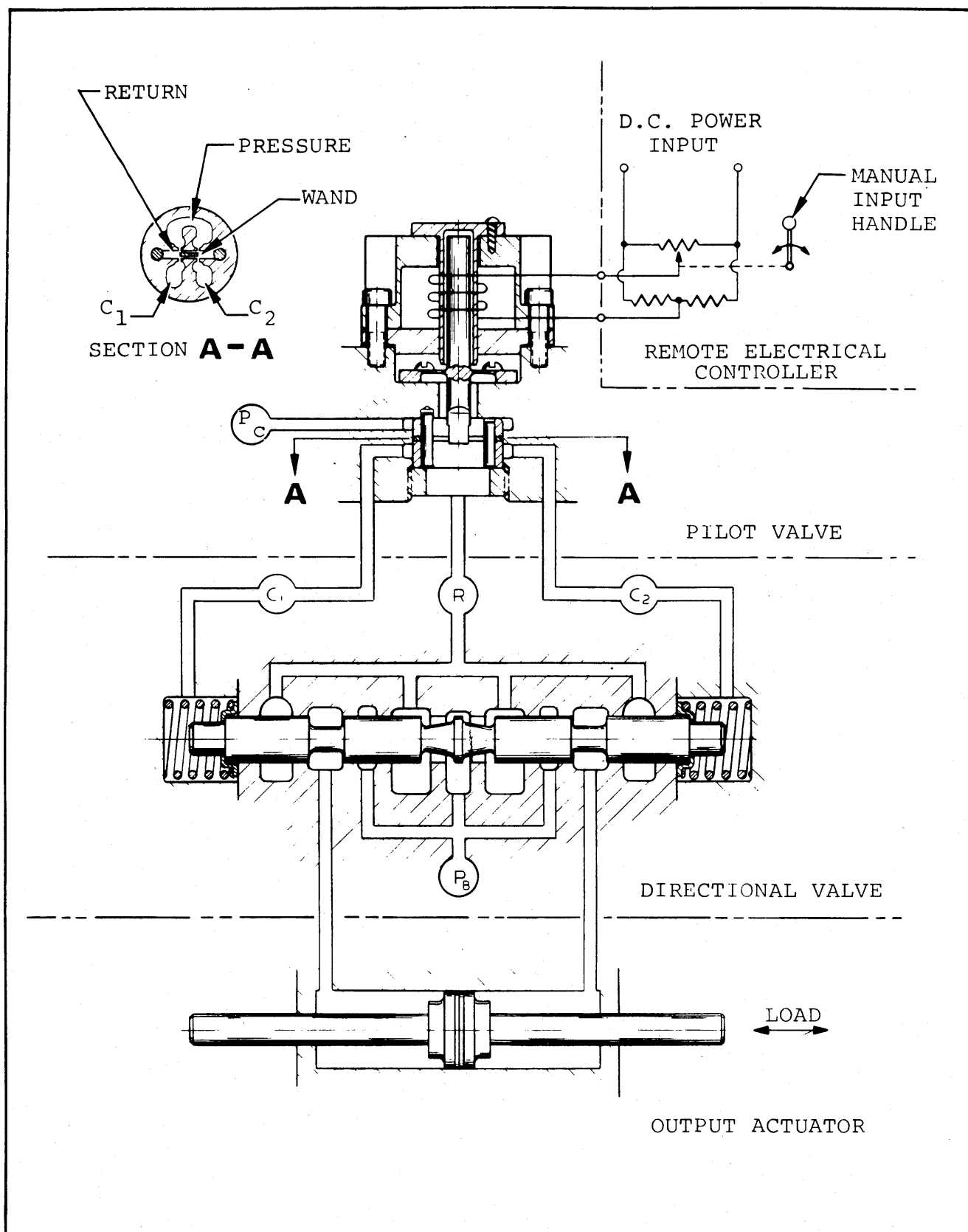


FIGURE I

The BerteA proportional electrohydraulic control valve is a stack configuration to provide remote control for open center systems. The basic module consists of an inlet manifold assembly, a number of directional valve section assemblies with pilot valves, plus an outlet manifold assembly as shown in Figure 1.

In order to provide control for an open center system when the main power pump is ported to tank at minimum pressure, the module design contains two separate hydraulic circuits. These include the main power pump circuit in the normal manner for cylinder port control plus a 300 psi control pressure circuit for the pilot valves. The control pressure is to be supplied by a separate pump or fluid source operating continuously at 300 to 400 psi. Each pilot valve requires continuous flow of .5 to .6 gpm.

The valve is designed for open loop, visual feedback control of hydraulic circuits at supply pressures up to 2500 psi and flow rates to 30 gpm. The recommended viscosity range is 50 to 2000 SSU for continuous operation. Operating temperature -30°F to 200°F .



SCHMATIC
SINGLE FUNCTION OPEN CENTER REMOTE CONTROL VALVE
FIGURE 2

OPERATION (Reference Figure 2)

The Berteau valve system converts a low power electrical signal into a high hydraulic power output. The signal generation can be from a remote hand controller that is connected to the module by wires or can be a remote radio control unit without direct wire connections.

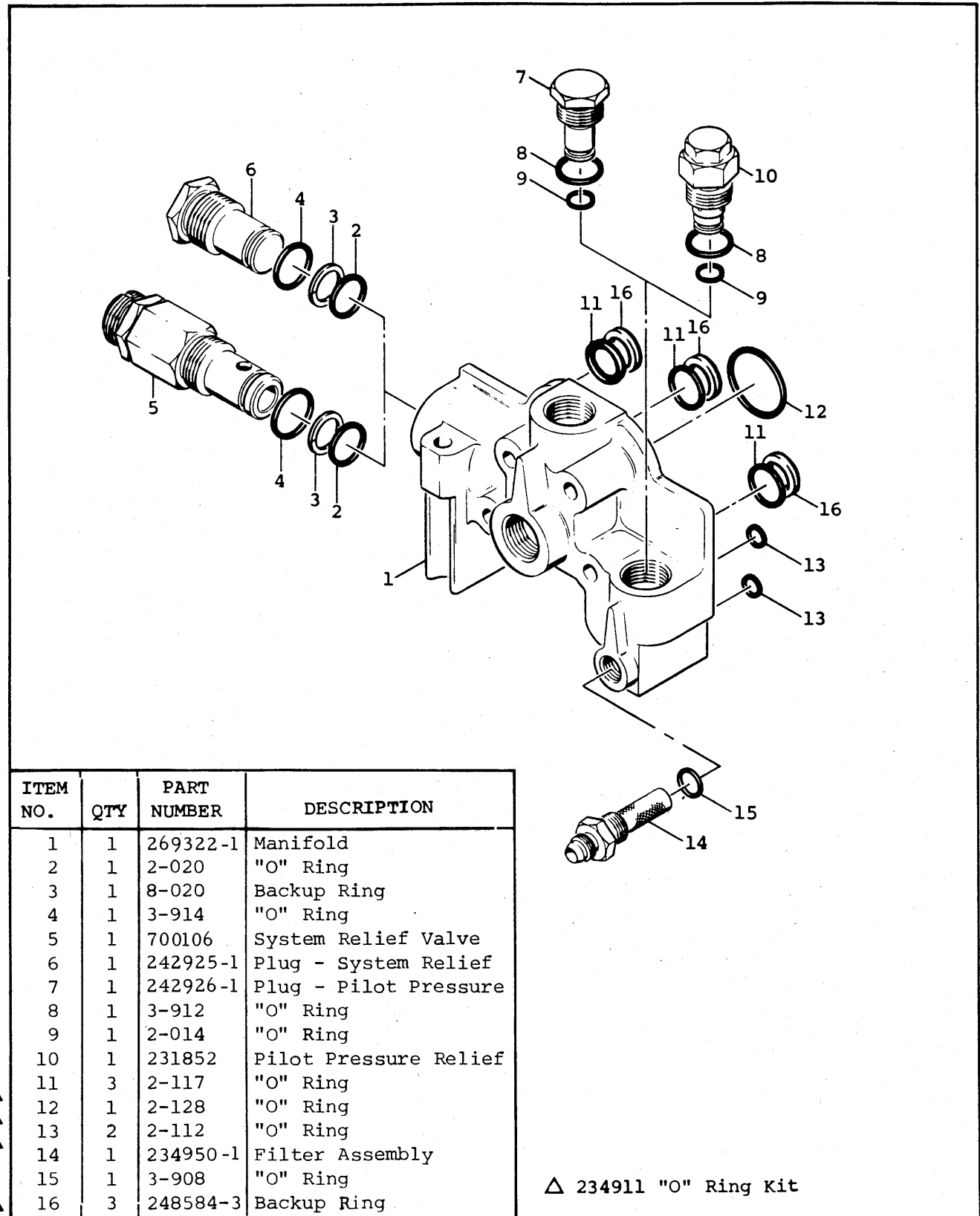
The remote hand controller provides a signal that is proportional to lever position and operates on 12 VDC. The power draw in the controller is approximately 2.0 watts.

The pilot valve is a jet diverter configuration of a transfer valve that provides proportional pressure control by moving the jet diverter in the fluid stream. The valve operates on 300 psi differential pressure and requires a continuous flow of .5 to .6 gpm. The output of the valve is proportional to command since the movement of the diverter wand is proportional to the voltage applied to the torque motor.

The diverter wand is located in a manner to partially block the flow of the fluid from the pressure port to each cylinder port. When the wand is in the neutral position, the pressure in each control port (C_1 and C_2) will be equal. As the wand is moved in response to the command signal it will interrupt the flow to one control port more than the other. This creates a differential pressure between the two control ports that is proportional to the command signal.

The output of the pilot valve is ported to each end of the spool of the directional valve. This valve is an open center design with the pressure beyond porting as a parallel circuit. The spool is spring caged to neutral which provides 19# detent force. In addition, the spool design contains .100 inch overlap travel prior to metering the cylinder ports. As a pilot valve varies the control pressure on each end of the spool, creating a pressure unbalance, the spool will move to a position proportional to the signal. The spool position is determined by the balance of differential pressure versus spring load.

It should be noted that open center type valves contain two flow paths for the main power circuit. The open center porting connects the pump to tank when the spool is in the center position plus the pressure beyond porting that supplies the cylinder ports with power fluid. The spool movement must close off the open center porting in a manner to provide a smooth rise in pump pressure. This will permit the slow operation of a cylinder with the pump pressure slightly above load pressure rather than relief valve setting.



MANIFOLD ASSEMBLY, PART NO. 269381

FIGURE 3

FILTRATION AND HYDRAULIC SYSTEM PREPARATION

The life of any hydraulic system is sensitive to the cleanliness of the fluid stream. It is recommended that good cleaning and flushing procedures be followed in the assembly and test of the system.

The purpose of separating the control pressure fluid from the main power circuit fluid as shown on Figure 7 is to assure continuous filtration of the fluid supply to the pilot valves. A 40 micron full flow, non bypass filter is required for the control pressure circuit. The minimum flow rate will be based on the number of pilot valves used, it is recommended that a unit as large as possible be used to insure long filter life.

The main power fluid circuit filtration should be 10 micron as shown on Figure 7. A suction strainer on the pump and magnetic tank unit are beneficial to filter life.

A secondary filter is installed in each inlet section (see Figure 3) to provide pilot valve protection from contamination generated between the main control fluid filter and the valve.

ASSEMBLY AND SERVICE

The Berteau proportional electrohydraulic control valve module can be mounted in any position or attitude. It is not sensitive to vibration or shock. The stack configuration permits the use of multiple spool sections and the optional tandem outlet facilitates the use of dual pumps.

A. INLET MANIFOLD ASSEMBLY (Figure 3)

The inlet manifold provides the inlet porting for the main power fluid circuit and the pilot valve fluid circuit. An optional 30 gpm system relief valve cartridge (Item 5) is available to replace the standard plug assembly (Item 6) for the power fluid circuit.

Each vehicle installation requires only one control pressure relief valve (Item 10), to maintain the 300 psi control pressure, regardless of the number of modules used. This valve should be installed in the module that is the greatest distance from the pump in order to assure a minimum of 300 psi pilot valve supply pressure to all units. The other inlet sections would use the standard plug assembly (Item 7). This pressure relief valve will provide 300 psi differential pressure for the pilot valve supply regardless of tank pressure. Therefore, if the vehicle return line has 100 psi back pressure the inlet to the pilot valves will be 400 psi.

All inlet sections contain the pilot valve filter assembly (Item 14) regardless of the location of the pressure relief valve. The replacement schedule of this filter will be determined by the system usage and the quality of filtration of the power circuits.

The "O" ring face seals are the same as the ones used in the directional valve section (Figure 4). Care should be taken to assure that each ring is in its respective groove when clamping a module together.

B DIRECTIONAL VALVE SECTION ASSEMBLY (Figure 4)

Each directional valve section consists of a spool valve assembly plus the pilot valve. The spool section body is a 30 gpm configuration with optional spools for lower flow rates. The majority of the components are basic with variations available in manual override of a remote controlled spool plus a standard lever operated spool.

The load drop check valve (Items 12, 13, 14, and 15) is a standard component that prevents flow from the cylinder ports back to the pressure beyond line. This prevents the higher loaded cylinder from dropping in the event a second spool is actuated to a lower pressure load. The poppet and spring may be removed for functions that require flow back into the supply port.

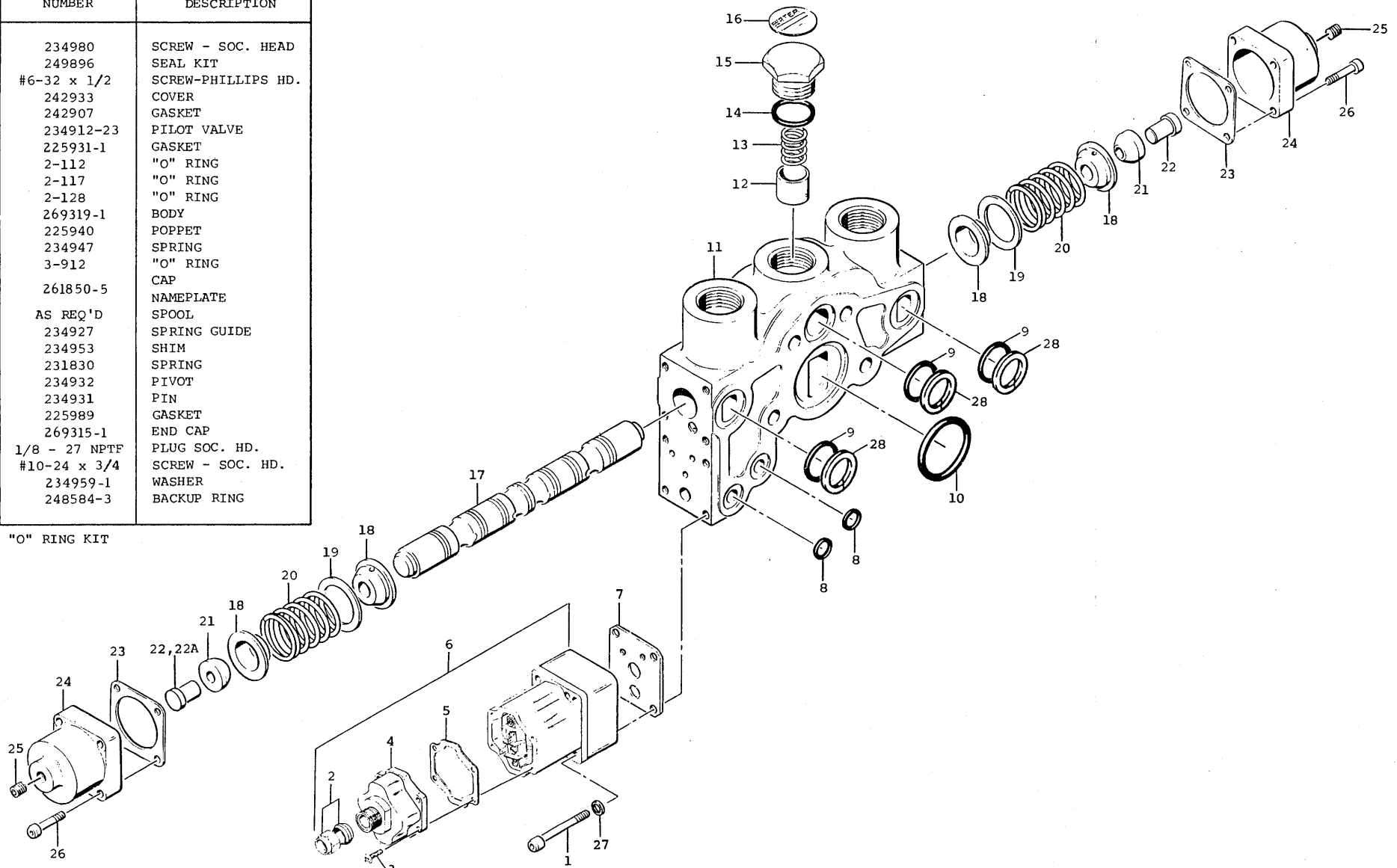
The manual override assembly for a remote controlled spool is shown in Figure 5. This assembly will provide direct manual control of the spool in the event of a failure in the remote controller, the electrical power supply, or a malfunction of the pilot valve.

The hand knob is held in the thread disengaged position by a light spring to prevent inadvertent operation. Press the knob inward while rotating to engage the threads in the cap and the drive screw. Continued rotation clockwise will move the spool from center and will provide flow from the cylinder port adjacent to this end cap. The knob must be rotated outward and disengaged prior to operating the manual override on the opposite end cap.

A plug is provided, as shown, to bleed the air from each end cap after initial assembly and operation. Air trapped in the spool end cap will reduce the response of the valve assembly.

ITEM NO.	QTY	PART NUMBER	DESCRIPTION
1	4	234980	SCREW - SOC. HEAD
2	1	249896	SEAL KIT
3	4	#6-32 x 1/2	SCREW-PHILLIPS HD.
4	1	242933	COVER
5	1	242907	GASKET
6	1	234912-23	PILOT VALVE
7	1	225931-1	GASKET
8	2	2-112	"O" RING
9	3	2-117	"O" RING
10	1	2-128	"O" RING
11	1	269319-1	BODY
12	1	225940	POPPET
13	1	234947	SPRING
14	1	3-912	"O" RING
15	1	261850-5	CAP
16	1		NAMEPLATE
17	1	AS REQ'D	SPOOL
18	4	234927	SPRING GUIDE
19	2	234953	SHIM
20	2	231830	SPRING
21	2	234932	PIVOT
22	2	234931	PIN
23	2	225989	GASKET
24	2	269315-1	END CAP
25	2	1/8 - 27 NPTF	PLUG SOC. HD.
26	8	#10-24 x 3/4	SCREW - SOC. HD.
27	4	234959-1	WASHER
28	3	248584-3	BACKUP RING

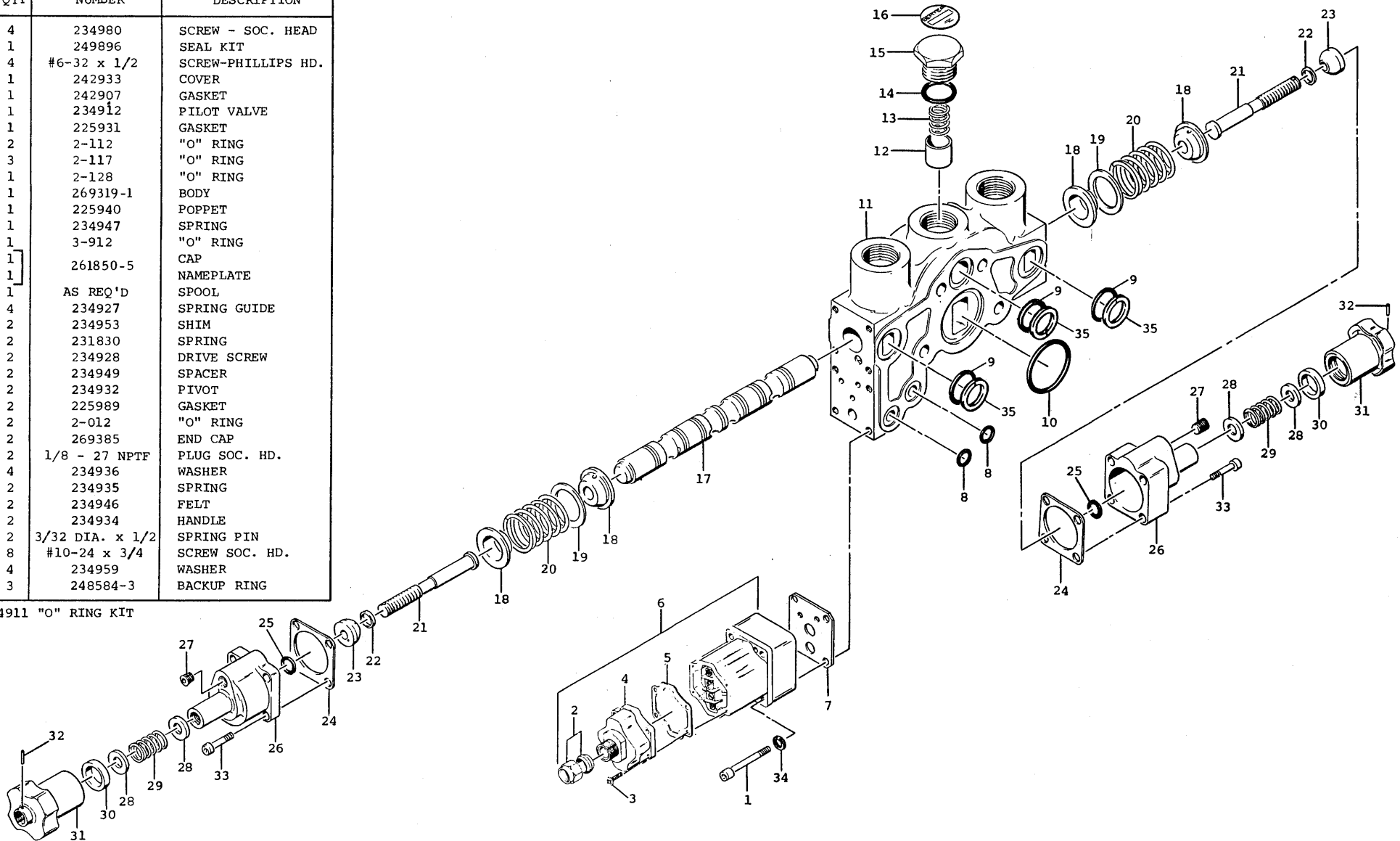
△ 234911 "O" RING KIT



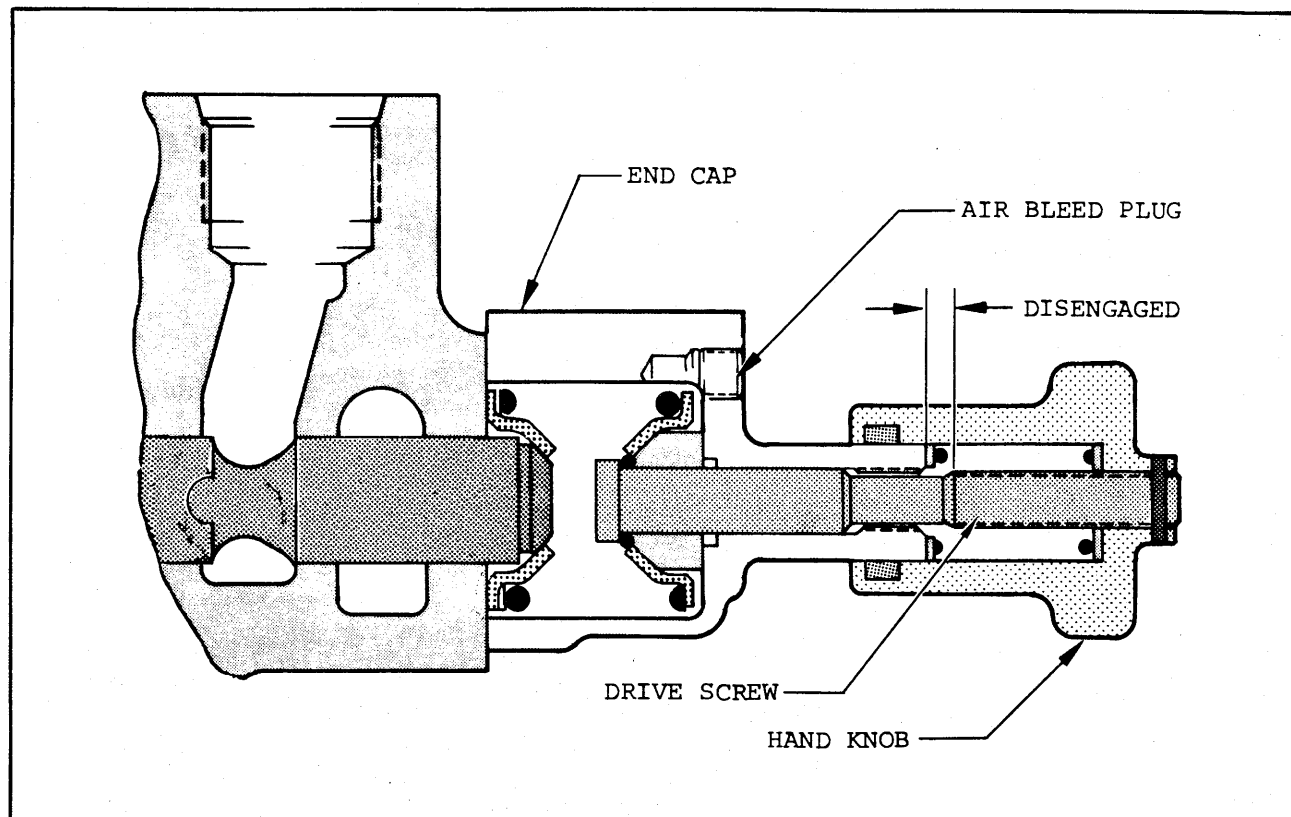
DIRECTIONAL VALVE ASSEMBLY
FIGURE 4A

ITEM NO.	QTY	PART NUMBER	DESCRIPTION
1	4	234980	SCREW - SOC. HEAD
2	1	249896	SEAL KIT
3	4	#6-32 x 1/2	SCREW-PHILLIPS HD.
4	1	242933	COVER
5	1	242907	GASKET
6	1	234912	PILOT VALVE
7	1	225931	GASKET
8	2	2-112	"O" RING
9	3	2-117	"O" RING
10	1	2-128	"O" RING
11	1	269319-1	BODY
12	1	225940	POPPET
13	1	234947	SPRING
14	1	3-912	"O" RING
15	1	261850-5	CAP
16	1		NAMEPLATE
17	1	AS REQ'D	SPOOL
18	4	234927	SPRING GUIDE
19	2	234953	SHIM
20	2	231830	SPRING
21	2	234928	DRIVE SCREW
22	2	234949	SPACER
23	2	234932	PIVOT
24	2	225989	GASKET
25	2	2-012	"O" RING
26	2	269385	END CAP
27	2	1/8 - 27 NPTF	PLUG SOC. HD.
28	4	234936	WASHER
29	2	234935	SPRING
30	2	234946	FELT
31	2	234934	HANDLE
32	2	3/32 DIA. x 1/2	SPRING PIN
33	8	#10-24 x 3/4	SCREW SOC. HD.
34	4	234959	WASHER
35	3	248584-3	BACKUP RING

△ 234911 "O" RING KIT



DIRECTIONAL VALVE ASSEMBLY
FIGURE 4B



MANUAL OVERRIDE
FIGURE 5

C OUTLET MANIFOLD (Figure 6)

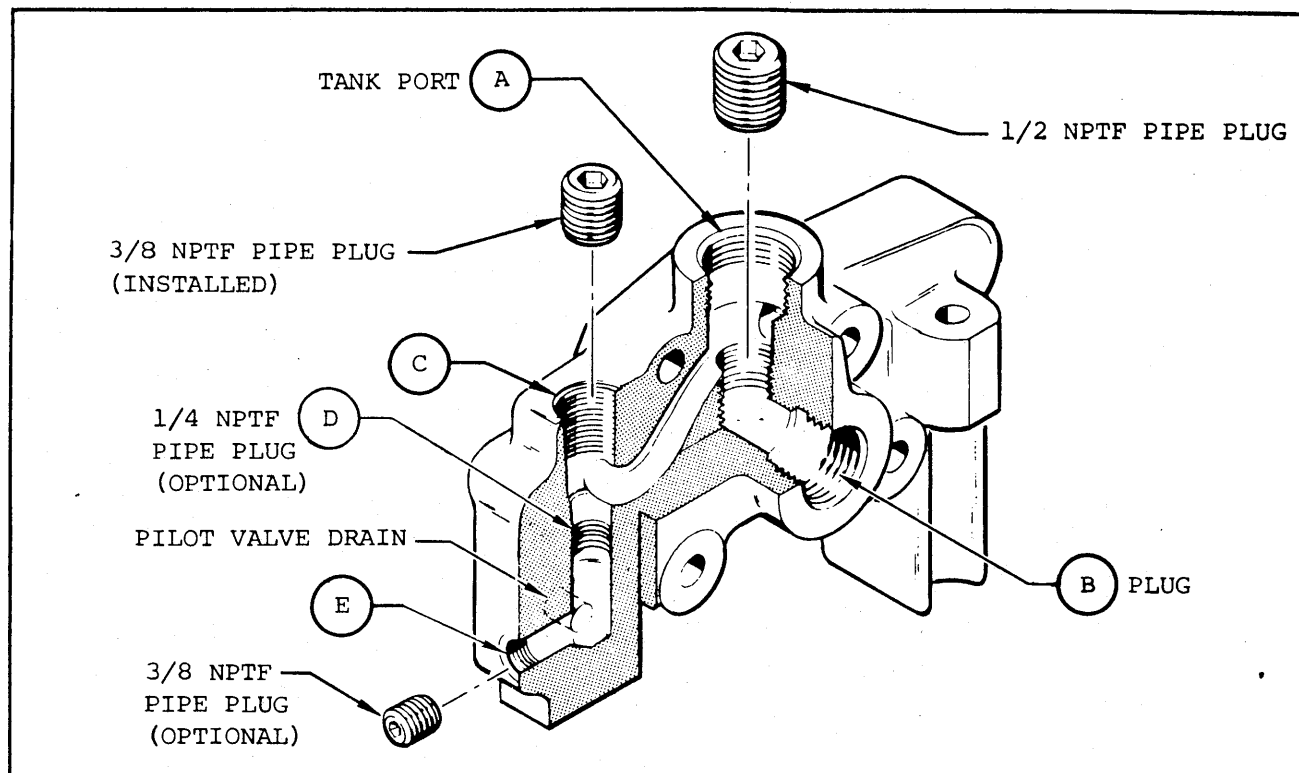
The outlet manifold provides a dual function of being the end section with connections to tank for the standard module plus providing pressure beyond capability as a tandem outlet.

The Berteia outlet manifolds contain two optional plumbing configurations.

One option relates to the main system fluid and use of the 1/2 NPTF pipe plug inserted through port "A". When an outlet manifold is used without the internal pipe plug, either port can be connected to the reservoir line.

The tandem outlet configuration is created when a pipe plug is inserted through the port labeled "A" which thus separates the normal tank lines of the valve stack from the open center porting. In this configuration, the "A" port must be connected to tank and the "B" port used to carry the fluid to the next valve stack for the power beyond configuration.

When operating as a closed center circuit, the plug is installed; port "A" is connected to tank and port "B" is plugged.



OUTLET MANIFOLD, PART NUMBER 269382
FIGURE 6

C OUTLET MANIFOLD (Continued)

The other option relates to the method of connecting the pilot valve drain line to tank which is determined by the location of the optional 1/4 pipe plugs. If the main system return line pressure does not exceed 100 psi, the pilot valve drain can be ported to this circuit within the manifold by inserting the plug into port "E". (Omit 1/4 NPTF plug at "D").

If high system back pressure is anticipated, the 1/4 NPTF plug should be inserted into port "D" and the pilot valve drain connected to the tank through port "E".

The 3/8 NPTF plug is only for access to port "D".

D. PILOT VALVE

The pilot valve ratings include the following:

Coil	60 ohm resistance
Operating Current	60 ma
Operating Voltage	3.6 volts
Maximum Current	100 ma rated
Required Flow . . . . .	.5 to .6 gpm at 300 psi differential

D. PILOT VALVE (Continued)

The correct mounting orientation of the pilot valve is determined by the locating pin in the pilot valve body. Care must be exercised to assure correct matching of the gasket between the two faces.

A positive polarity of the red wire of the pilot valve will provide flow from the cylinder port adjacent to the pilot valve.

There are no external adjustments for the pilot valve nor mechanical connections to the spool. If a problem related to the pilot valve develops the unit should be replaced and returned to the factory.

TROUBLE SHOOTING

The modular design of the valve provides simple field trouble shooting and service. The first step should be to isolate the problem to a specific component if possible. For example, change the remote controller leads from one pilot valve to another to check if the problem follows the remote controller.

The same procedure can then be used to check the pilot valves by interchanging two units. Care should be taken to avoid introducing dirt into the system when removing pilot valves.

The pilot valve converts an electrical input signal of 0 to 3.6 volts into a pressure unbalance across the directional valve spool. At the factory setting of 300 psi differential pressure across the pilot valve, the directional valve spool deadband will be a minimum of 20%. Increasing the differential pressure across the pilot valve will reduce the deadband significantly.

Control problems are usually either electrical, hydraulic or mechanical.

Electrical problems are isolated by disconnecting the wires from the pilot valve to determine if the problem is caused by the remote electrical controller or the pilot valve.

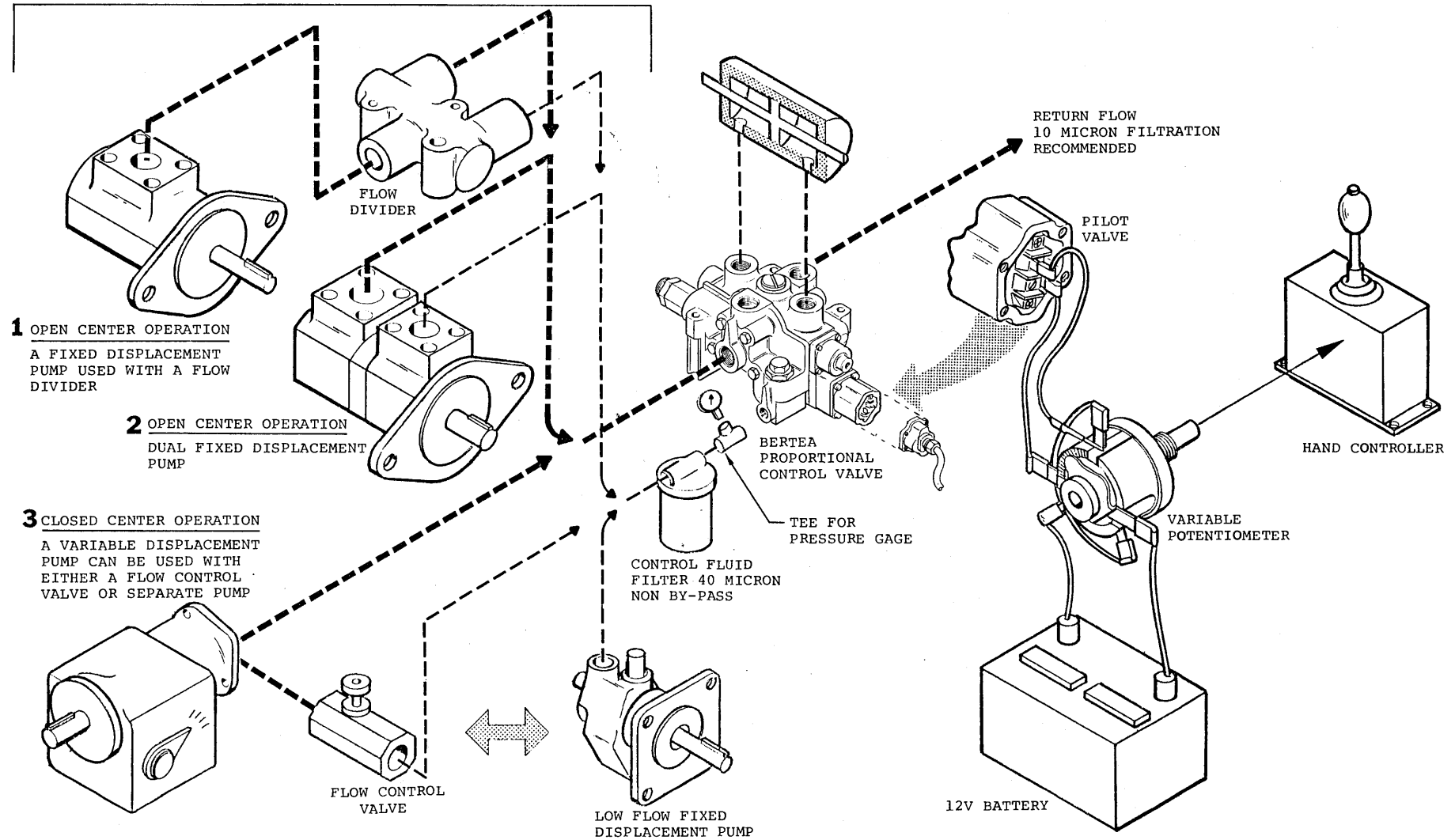
Hydraulic control problems, such as poor feathering, can be caused by very high or very low differential pressure across the pilot valve. Hydraulic mal-function problems, such as unwanted motion or non operation, can be caused by contamination failures. Check the control system filter and the inlet manifold filter (Item 14, Figure 3) for plugging or failure. Replace the pilot valve with a spare unit or one from another function to check for a plugged valve.

Mechanical failure, such as a broken part or mechanical null shift, can be checked by replacing the pilot valve.

TROUBLE SHOOTING CHART

POTENTIAL TROUBLE	PROBABLE CAUSE	REMEDY
Control valve does not respond to command	<ol style="list-style-type: none"> 1. Controller does not provide signal (60 ma max reqd) 2. Open wire in control cable. 3. Shorted Terminal connection. 4. Pilot valve mounted incorrectly. 5. Failed pilot valve 6. Jammed spool 	<ol style="list-style-type: none"> 1. Replace Controller 2. Replace cable 3. Check for terminal end contacting case or poor clamping of wire ends on terminal strip. 4. Check for matching porting of pilot valve to spool section. 5. Replace pilot valve 6. Remove end cap and check spool freedom.
High null bias (Actuator drifts or hydraulic motor slowly rotates when controller returns to neutral)	<ol style="list-style-type: none"> 1. Failed controller resulting in a command at neutral position. 2. Failed pilot valve 3. Sticking spool due to contamination. 	<ol style="list-style-type: none"> 1. Replace controller 2. Replace pilot valve 3. Remove end cap and check spool freedom.
Low flow rate from cylinder port, motor turns slowly or cylinder moves slowly at maximum command.	<p>Directional valve spool is not traveling far enough.</p> <ol style="list-style-type: none"> 1. Caused by low pressure gain of pilot valve. 2. Caused by low control pressure supply. 3. Plugged pilot valve 	<ol style="list-style-type: none"> 1. Check filter in the inlet section for plugging. 2. Replace pressure regulator if necessary. 3. Change pilot valve
Poor response, function shuts off slowly when command is removed.	<ol style="list-style-type: none"> 1. Restricted tank return line. 2. Low spool spring preload. 3. Sticking spool due to contamination. 4. Air in end caps. 	<ol style="list-style-type: none"> 1. Check for restrictions in tank return line. 2. Check for correct spring and shims in end caps. Remove end cap and check spool freedom. 4. Bleed air from end caps

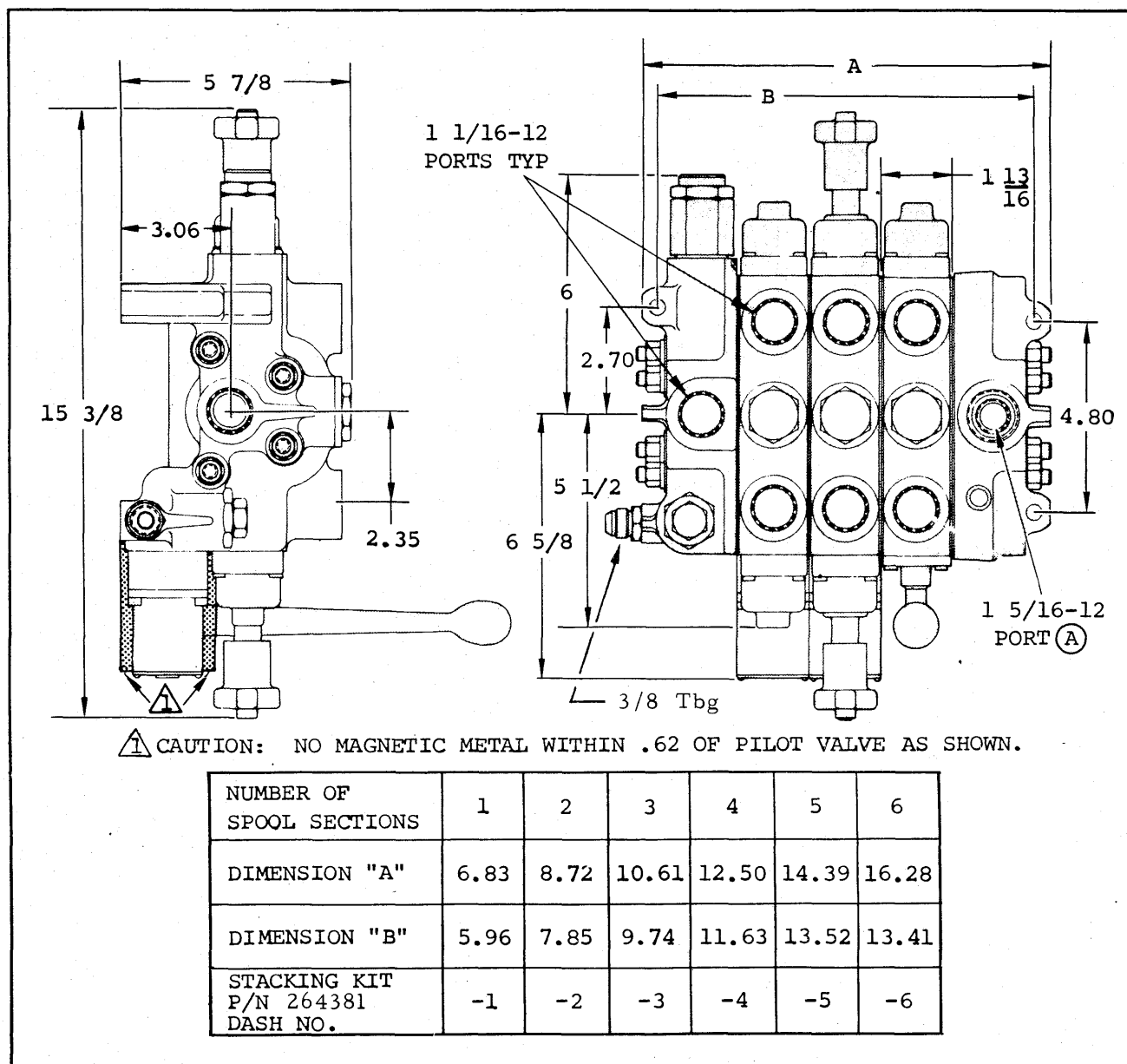
PUMP OPTIONS



BERATEA VALVE INSTALLATION
FIGURE 7

INSTALLATIONMODULE ASSEMBLY

Insert the "O" rings into the respective grooves of the inlet manifold and spool sections. Assemble the required number of spool sections between the inlet and outlet manifolds with the pilot valve porting on the right hand side as shown in Figure 8. Use a flat surface for support in order to align the inlet and outlet manifolds. Torque the clamping bolts as noted on Page 15.



INSTALLATION
FIGURE 8

The valves are not sensitive to attitude and therefore may be installed in any reasonable manner on the vehicle. Caution should be exercised to avoid placing steel tubing or magnetic material within 1.5 inches of the pilot valve as shown in Figure 8. Magnetic material will affect the flux field of the pilot valve permanent magnet and will cause a major shift in the valve null position.

The optional configurations of the inlet manifold assembly are shown in Figure 3. If the 234905 system relief valve is not required, the 225946 plug must be used in the port in order to provide the correct seals for the internal lands.

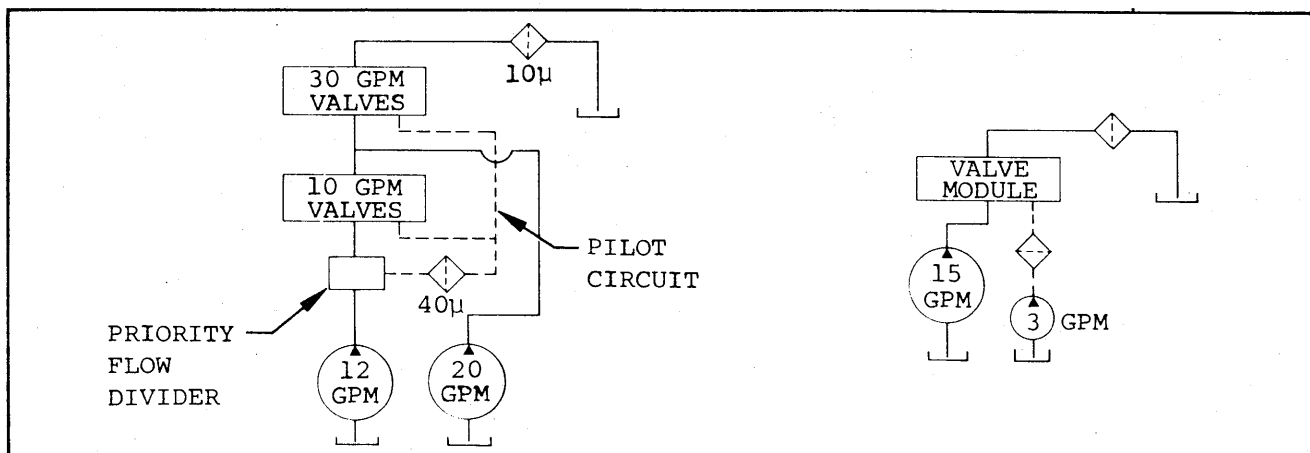
PORT SIZES

Cylinders	. . . . .	1-1/16 - 12 (3/4 tube)
Inlet	. . . . .	1-1/16 - 12 (3/4 tube)
Outlet	. . . . .	1-1/16 - 12 (3/4 tube)
Control Pressure	. . . . .	3/8 Flared tube-male

BOLT TORQUES

3/8 - 16 Clamping Studs	. . . . .	23 lb-ft - Lube
	. . . . .	30 lb-ft - Dry
10 - 24 Screws	. . . . .	30 in-lb - Lube
	. . . . .	40 in-lb - Dry

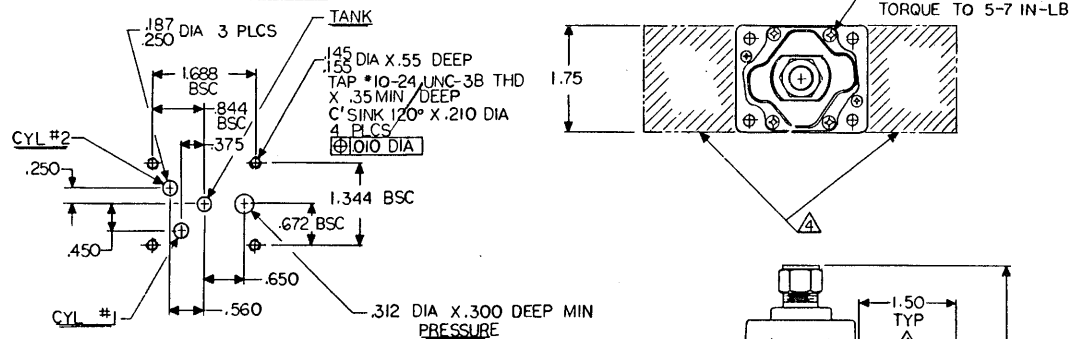
The 231852 pilot pressure relief valve establishes the 300 psi differential pressure for the pilot valve circuit. Only one pilot pressure relief valve is required per vehicle and therefore when two or more modules are used, this port must be closed with a 231856 plug in the extra modules. Each pilot valve requires a continuous flow of .5 to .6 GPM at 300 psi ΔP . A four spool section installation would require four times .5 GPM plus 1.0 GPM for assurance or a .30 GPM supply. Figure 9 shows typical installations of a separate pump for pilot fluid supply and a circuit using a priority flow divider. A 40 μ filter is required as shown for this pilot fluid circuit.



PILOT FLUID CIRCUITS

FIGURE 9

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MOUNTING FACE
(REQ'D FOR MOUNTING MANIFOLD)

NOTES:

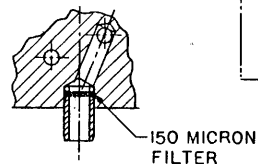
1. TECHNICAL DATA

DIFFERENTIAL PRESSURE	300 PSI
QUIESCENT FLOW	.5 TO .6 GPM
COIL RESISTANCE	60 OHMS
RATED CURRENT	60 MA
FILTRATION	25 MICRON
RATED VOLTAGE	60 MA 3.6 VOLTS DC
FLUID	PETROLEUM OIL
WEIGHT	.85 LB/385 GM

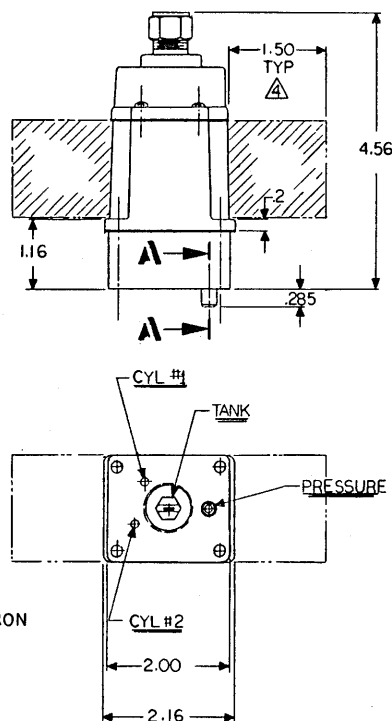
2. WHEN RED WIRE IS POSITIVE, PRESSURE AT CYL #2 IS GREATER THAN CYL #1.

3. FOR MOUNTING, USE BERTEA SCREW P/N 234980 (10-24 X 1-1/2 SOC HEAD CAP SCREW - NON MAGNETIC CRES), AND BERTEA GASKET P/N 225931 TORQUE TO 38-42 IN-LBS DRY 4 PLC, USE BERTEA WASHER P/N 234959 UNDER HEAD OF SCREW.

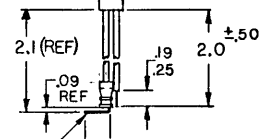
CAUTION: NO MAGNETIC MATERIAL ALLOWED WITHIN AREA SHOWN.



SECTION A-A



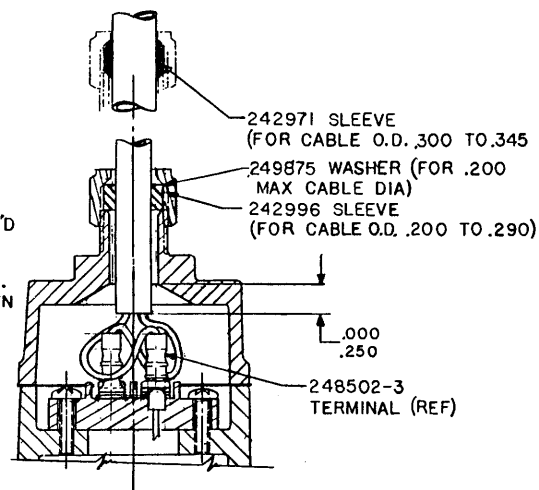
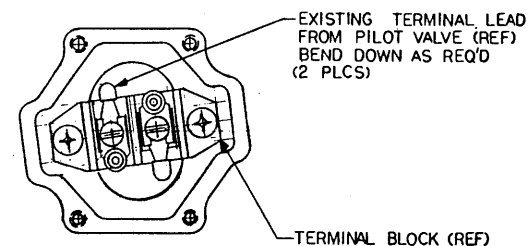
CABLE O.D.
.200 TO .345
(2 CONDUCTORS
16 TO 20 GA.)



248502-3 TERMINAL 2 REQ'D
(BERTEA FURNISHED)
(AMP SPECIAL IND.
P/N 327043 BEFORE BEND).
STRIP INSULATION AS SHOWN
AND CRIMP WITH ONE OF
THE FOLLOWING CRIMPING
TOOL:

AMP SPEC. IND. NO. 29564
VACO CORP. NO. 1902
THOMAS & BETTS
NO. WT1000
HOLLINGSWORTH
SOLDERLESS TERMINAL CO
NO. H2A
OR EQUIV. TOOL

CUSTOMER'S CABLE



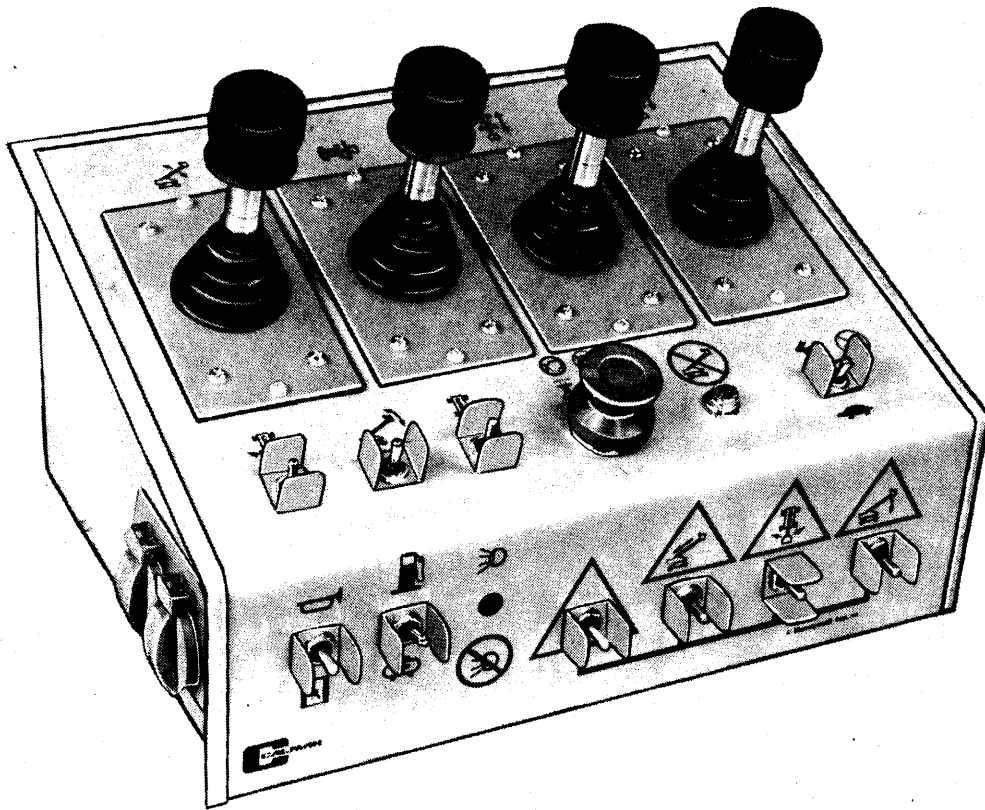
TERMINAL CONNECTIONS
2X SIZE

TABLE OF ELECTRICAL CABLES REF.			
TYPE	NO. OF COND.	WIRE SIZE	O.D. (REF)
SJO	2	18 AWG	.300
SJO	2	16 AWG	.330
SDN	2	18 AWG	.278
SDN	2	16 AWG	.292

PILOT VALVE INSTALLATION
FIGURE 10

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Honeywell



FORM NUMBER
95-8957

MCP101A

Aerial Lift Control Console

INSTRUCTIONS Aerial Lift Control Console MCP101A

APPLICATION

The MCP101A Aerial Lift Control Console is designed exclusively for use on the Calavar self-propelled Condor.

Two control panels are available, one designed to operate a 60 ohm (Bertea Control Valve) load and the other to operate a 6 ohm (HPI Control Valve) load.

The panel provides the required electrical output for the following machine functions:

- engine start,
- engine stop,
- vehicle steer,
- bucket tilt,
- bucket rotate,
- boom raise and lower,
- boom rotate,
- boom extend and retract,
- vehicle forward and reverse,
- emergency boom descend,
- emergency boom rotate,
- emergency boom retract,
- vehicle speed,
- choke/horn and
- LP/gas (standard on HPI, optional on Bertea).

Boom raise and lower, boom rotate, boom extend and retract and vehicle forward and reverse are proportional functions actuated through spring-return control handles. All others are actuated through switches. Except for the LP/gas switch, both control panels have the same functions, and component locations are identical from one to the other.

SPECIFICATIONS

ENVIRONMENTAL

TEMPERATURE

-34° to 66° C (-30° to 150° F)

HUMIDITY

After being placed in a controlled atmosphere of 95% humidity at 49° C (120° F) for 10 days, the Console will perform within specification limits.

VIBRATION

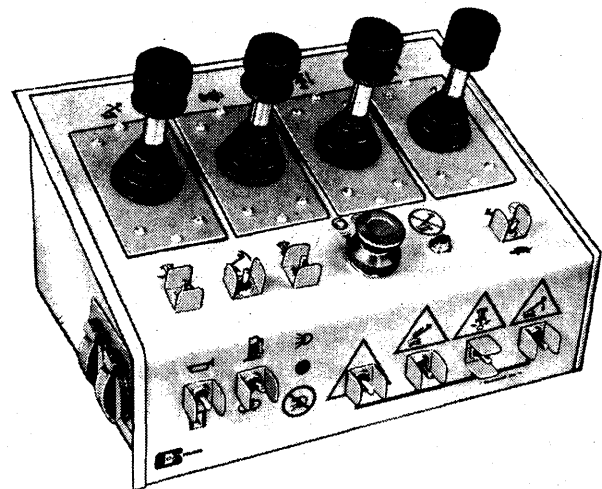
Withstands a vibration test designed for mobile equipment controls consisting of two parts:

1. Cycling from 5 to 2000 Hz in each of the three axes.
2. Resonance dwell for one million cycles for each resonant point in each of the three axes.

Run from one g to three g's. Acceleration level varies with frequency.

SHOCK

50 g for 11 milliseconds. Three shocks in both direc-



tions of the three mutually perpendicular axes for a total of 18 shocks.

RAIN

After being showered from all directions by a high pressure hose down, the Console will perform within specification limits. This test fulfills NEMA 4 specifications.

MECHANICAL

HANDLE STROKE

$\pm 30^\circ$ ($\pm .52$ radians)

HANDLE SPRING TORQUE

1.2 \pm .4 N-m (11 \pm 4 in.-lbs.) on center breakaway
2.0 \pm .7 N-m (18 \pm 6 in.-lbs.) at full stroke

HANDLE LIFE

1,000,000 cycles

DIMENSIONS

See Figure 1.

ELECTRICAL

OPERATING VOLTAGE

11 to 15 Vdc

JUMP-UP

12 ma (Berta Handle). See Figure 2.
0 to 800 ma, adjustable (HPI Handle). See Figure 3.

OUTPUT CURRENT

60 \pm 15 ma (Bertea Handle). See Figure 2.
-0
.25 to 1.25 amps, adjustable, above threshold setting, to a maximum of 1.5 amps (HPI Handle). See Figure 3.

SPECIFICATIONS (continued from page 1)

POWER

- 5 watts (centered, Bertea)
- 9 watts (full stroke, Bertea)
- 0 watts (centered, HPI)
- 25 watts (full stroke, HPI)

LOAD RESISTANCE

- 60 ohms (Bertea)
- 6 ohms (HPI)

NULL CURRENT

- 0 amps

WIRING

A cable extends from the underside of each handle, terminating in a box connector with six male contacts.

The contacts are oriented per Figure 4. The cable is composed of six wires dedicated to the contacts shown in Figure 5.

The mating connector has a cable composed of six white wires. Each wire is stamped with a number identifying its function as specified in the Figure 6 wiring diagrams. Tables 1 and 2 list the point-to-point wiring connections to the wiring diagram for the Bertea and HPI Valve panels, respectively.

Three other connections are made external to the panel. First, the power plug connects into the underside of the panel. Second, a two-pin environmental connector plugs into the panel bottom to interlock ground speed with platform height. Third, electrical outlets on the panel side provide facilities for power tools. See Figure 1 for connection locations.

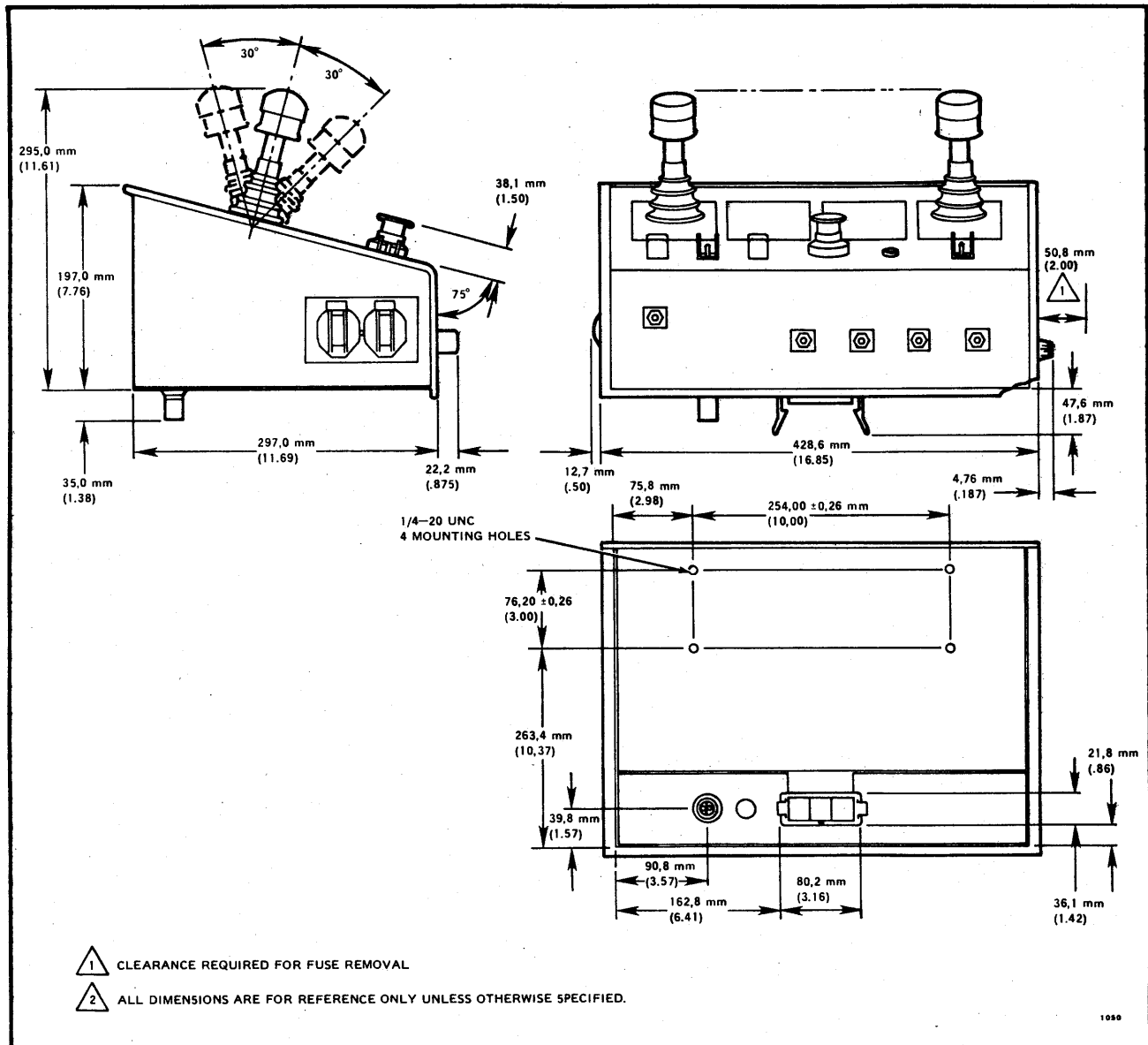


FIGURE 1. Dimension drawing of the MCP101A in millimeters (inches).

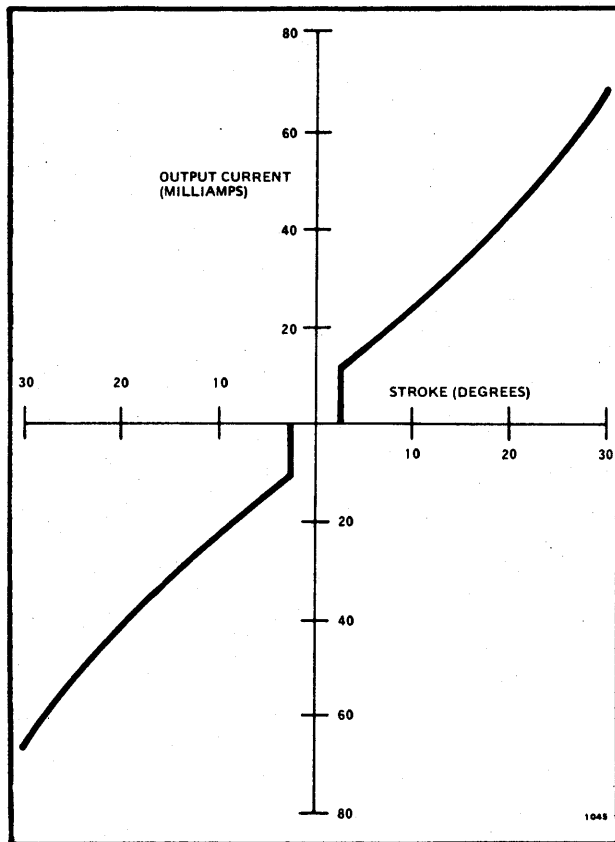


FIGURE 2. Output current versus handle stroke for Bertea-Style Control Handle. Supply voltage is 14 Vdc. Load resistance is 60 ohms.

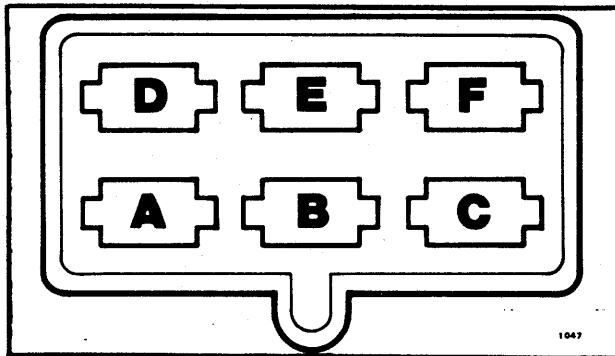


FIGURE 4. Male box receptacle from handle, as viewed facing towards pins.

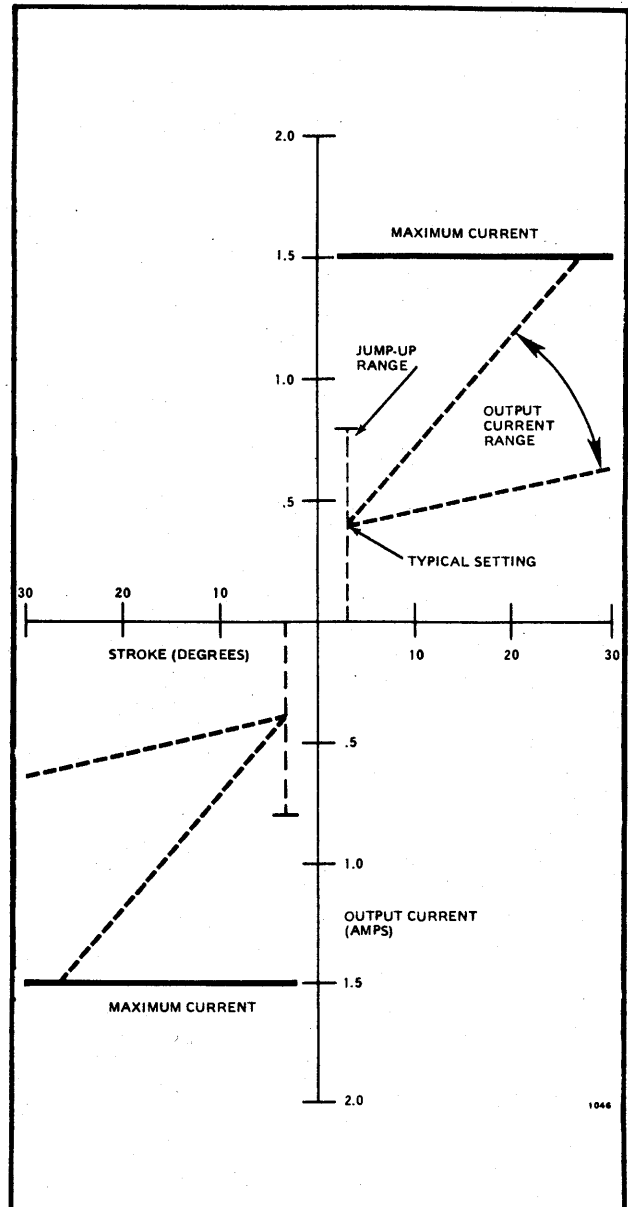


FIGURE 3. Output current versus handle stroke for HPI-Style Control Handle. Supply voltage is 14 Vdc. Load resistance is 7 ohms.

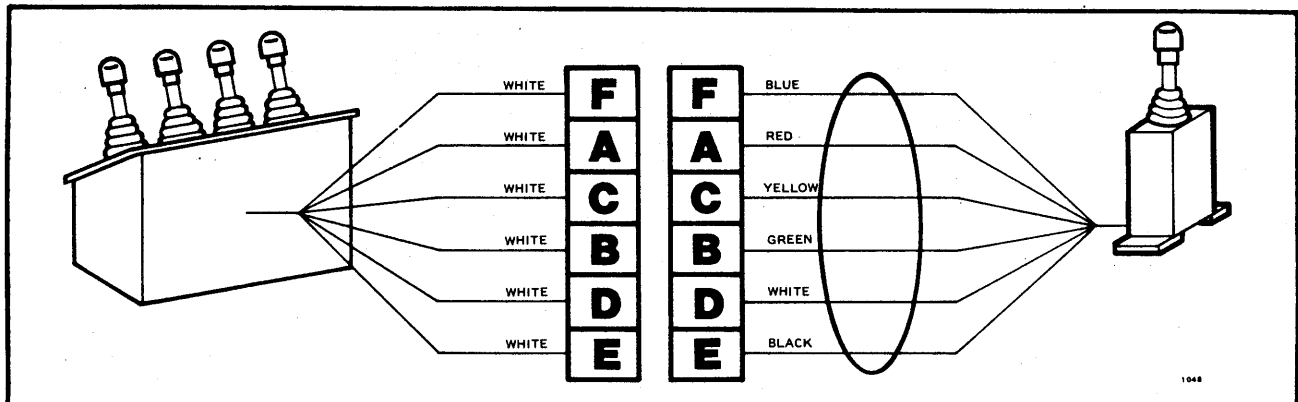
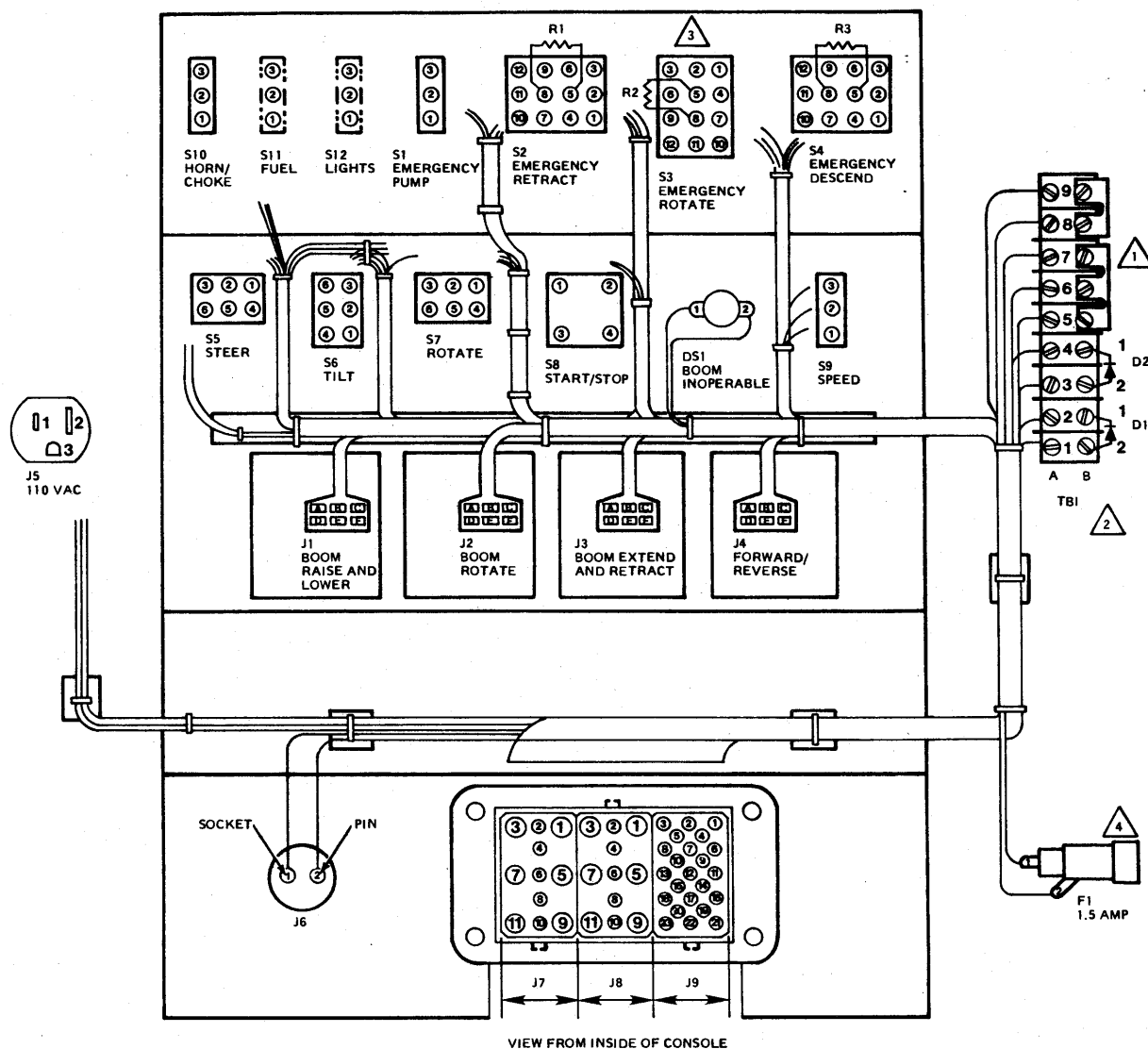


FIGURE 5. Handle-panel connection through receptacles, with color orientation.



- 1 FOR HPI, JUMPER TERMINALS 5, 6, 7 TOGETHER ONLY.
- 2 FOR HPI, INSTALL D2 BETWEEN TERMINALS 2 AND 3, CATHODE TOWARDS 2. INSTALL D3 BETWEEN 3 AND 4, CATHODE TOWARDS 3.
- 3 FOR HPI, DO NOT JUMPER PINS ON S2, S3, S4.
- 4 FOR HPI, NO FUSE IS INSTALLED.

1049

FIGURE 6. MCP101A wiring diagram.

TABLE I. Point-to-point wiring connections for the Berta Valve Panel. "To" and "From" locations are shown in Figure 6. Wire identification numbers are stamped on each wire.

LINE NO.	FROM	TO	WIRE I.D. NO.	LINE NO.	FROM	TO	WIRE I.D. NO.
1	J8-9	J6-1	55	49	TBI-7A	J3-E	4B
2	J6-2	S9-3	55A	50	TBI-7A	J2-E	4C
3	J7-5	J5-1	69	51	TBI-6A	J1-E	4D
4	J7-9	J5-2	70	52	S6-6	J1-C	B
5	J8-3	J5-3	1	53	S6-2	J1-F	47
6	J7-1	S8-3	3	54	S4-1	J1-B	18
7	J7-3	TBI-8A	4	55	S7-1	F1-2	B
8	J7-7	S5-5	6	56	S3-6	J2-B	22
9	J7-11	TBI-1A	57	57	S1-1	S2-8	3A
10	J8-1	F1-1	67	58	S2-8	S3-8	3A
11	J8-5	S2-7	68	59	S3-8	S4-8	3A
12	J8-11	S11-1	56	60	S8-3	S8-1	3
13	J7-8	TBI-5A	1	61	S1-2	S8-1	3
14	J8-2	S7-4	E	62	S2-2	S3-2	1
15	J8-4	DSI-2	H	63	S3-2	S4-2	1
16	J8-6	S8-2	25	64	S3-6	S3-1	22
17	J9-1	S6-1	23	65	S3-3	S3-4	21
18	J9-2	S4-1	18	66	S2-7	S3-9	68
19	J9-3	J4-D	13	67	S3-9	S3-7	68
20	J9-5	S9-1	60	68	S3-7	S4-7	68
21	J9-6	S6-3	24	69	S7-3	S7-1	B
22	J9-7	S2-1	19	70	S7-3	S6-4	B
23	J9-8	J4-B	14	71	S6-4	S6-6	B
24	J9-9	S11-3	50	72	S6-4	S5-1	B
25	J9-11	S8-4	26	73	S5-1	S5-3	B
26	J9-12	S2-4	20	74	S5-2	S5-5	6
27	J9-13	S5-4	15	75	S5-2	S6-5	6
28	J9-14	S10-1	59	76	S6-5	S7-2	6
29	J9-16	S7-6	27	77	S7-5	S7-2	6
30	J9-17	S3-4	21	78	TBI-8B	TBI-7B	
31	J9-18	S5-6	16	79	TBI-5B	TBI-6B	
32	J9-22	S3-1	22	80	TBI-2A	J2-C	B
33	J9-23	S4-4	17	81	TBI-2B	J3-C	B
34	S4-4	J1-D	17	82	S9-2	TBI-4A	F1
35	S3-4	J2-D	21	83	TBI-1B	D1-2	
36	J4-A	S7-5	6A	84	D1-1	TBI-2B	
37	J3-A	TBI-8A	4B	85	TBI-3B	D2-2	
38	J2-A	TBI-9A	4C	86	D2-1	TBI-4B	
39	J1-A	TBI-9A	4D	87	S2-8	S2-5	
40	TBI-1A	J4-C	57B	88	S3-8	S3-5	
41	TBI-3A	J4-F	F	89	S4-8	S4-5	
42	J9-4	S12-1	44	90	S8-3	S10-2	3
43	S2-4	J3-B	20	91	J7-6	TBI-5A	1
44	J9-10	S10-3		92	TBI-5B	DSI	1
45	TBI-2A	F1-2	B	93	TBI-6B	S4-2	1
46	S2-1	J3-D	19	94	TBI-8B	TBI-9B	
47	TBI-6A	TBI-5B	4	95	TBI-5B	TBI-7B	
48	TBI-6A	J4-E	4A				


TABLE II. Point-to-point wiring connections for the HPI Valve Panel. "To" and "From" locations are shown in Figure 6. Wire identification numbers are stamped on each wire.


LINE NO.	FROM	TO	WIRE I.D. NO.	LINE NO.	FROM	TO	WIRE I.D. NO.
1	J7-1	S8-1	3	45	J9-8	J4-B	14
2	J7-5	J5-1	69	46	J9-14	S10-1	59
3	J7-6	TBI-5B	1	47	J9-9	S11-3	50
4	J7-8	TBI-6B	1	48	J9-3	J4-D	13
5	J7-7	S7-2	6	49	J1-F	S6-5	47
6	J7-9	J5-2	70	50	TBI-2A	J3-C	67A
7	J7-11	TBI-3B	57	51	S3-1	J2-D	22A
8	J8-1	TBI-2B	67	52	S3-6	J2-B	21A
9	J8-3	J5-3	101	53	J3-B	S2-1	20A
10	J8-5	S4-4	68	54	TBI-4A	J1-D	18A
11	TBI-4A	S4-1	18	55	TBI-2A	J2-C	67C
12	J8-7	TBI-1B	61	56	J4-F	S9-2	48
13	J8-9	J6-2	49	57	S8-1	S8-3	3
14	J8-11	S11-1	56	58	S1-2	S8-1	3
15	J9-22	S3-1	22	59	S1-2	S7-5	3
16	J8-4	DSI-2	H	60	S7-5	S5-5	3
17	J7-3	TBI-8B	4	61	S1-1	S2-5	3A
18	J9-2	TBI-4B	18	62	S2-5	S2-2	3A
19	J9-5	S9-1	60A	63	S2-2	S3-5	3A
20	TBI-7B	DSI-1	1	64	S3-5	S3-2	3A
21	J9-17	S3-6	21	65	S3-2	S4-5	3A
22	J9-12	S2-1	20	66	S4-5	S4-2	3A
23	J9-18	S5-6	16	67	S4-4	S3-4	68
24	J9-6	S6-6	24	68	S3-4	S3-3	68
25	J9-13	S5-4	15	69	S3-3	S2-4	68
26	J9-16	S7-6	27	70	TBI-1A	S7-1	61
27	J9-1	S6-4	23	71	S7-1	S7-3	61
28	J8-2	S7-4	E	72	S7-3	S6-1	61
29	J8-6	S8-2	25	73	S6-1	S6-3	61
30	J9-11	S8-4	26	74	S6-1	S5-1	61
31	S5-2	S6-2	6	75	S5-1	S5-3	61
32	J6-1	S6-2	6	76	S7-2	S6-2	61
33	TBI-8B	J3-A	4B	77	TBI-5A	TBI-6A	
34	TBI-8A	J1-A	4D	78	TBI-6A	TBI-7A	
35	TBI-8A	J2-A	4C	79	TBI-1B	D1-2	
36	TBI-7A	J4-E	1A	80	D1-1	TBI-2B	
37	TBI-6A	J3-E	1B	81	TBI-2B	D2-1	
38	TBI-5A	J2-E	1B	82	D2-2	TBI-3B	
39	TBI-5A	J1-E	1D	83	TBI-3B	D3-1	
40	TBI-3A	J4-C	57A	84	D3-2	TBI-4B	
41	TBI-3A	J1-C	57D	85	J9-10	S10-3	
42	J9-23	J1-B	17	86	J9-4	S12-1	44
43	S5-2	J4-A	6	87		S10-2	
44	J9-7	J3-D	19	88		S11-2	

ADJUSTMENTS

The series resistance of the Berteau Handle at full stroke provides 66 ma, slightly greater than the 60 ma needed to fully shift the Berteau Valve. In order to maintain an initial step just below the 18 ma Berteau threshold, the nominal step height is set at 12 ± 3 ma.

Three holes are tapped in the side of the HPI Handle case to give access to trim pot adjustments, which are made with an instrument-type screw-driver. See Figure 7.

The top hole, labelled "T", is for the jump-up adjustment. The 15-turn potentiometer increases the jump-up amperage when turned counter-clockwise  and is factory-set at 35% of full-drive current, or 51 amps. This setting ensures that the hydraulic function starts just as the handle is moved off center.

The middle and bottom holes are for adjusting the gain of the output current vs. handle stroke relationship via single-turn potentiometers. The factory setting gives 1.5 amps (full drive for the HPI Valve) at 95-100% of full stroke. The middle hole, labelled "F", sets the forward handle (i.e., away from the operator) output and the bottom, labelled "R", sets the reverse (i.e., towards the operator) output. In both cases a clockwise  adjustment increases output current.

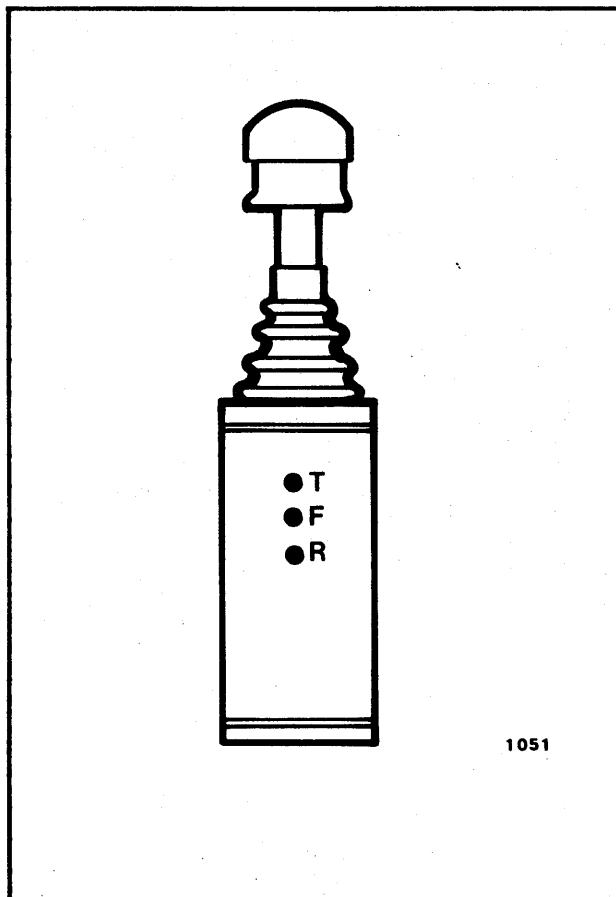


FIGURE 7. Location of three adjustment potentiometers on HPI Handle.

PARTS LIST

Parts listed herein are identified by corresponding numbers in Figure 8.

SWITCHES HONEYWELL NO.	MICROSWITCH NO.	DRAWING NO.
12000256-001	1TL1-3	1
12499875-001		2
12000255-001	2TL1-7	3
12000276-001	1TL1-61	4
12000255-003	4TL1-7	5
12000276-002	2TL1-61	6
12000276-003	4TL1-61	7
12000255-001	1TL1-7	8
EXTERIOR PANEL HOUSING		
12499892-001		9
DECAL LABEL		
12000257-001		10
COMPLETE PANEL WITHOUT HANDLES		
12499870-002 (B)		11
12499854-002 (H)		12
HANDLES		
MCH100J1007 (B)		13
MCH100L1005 (H)		14

ORDERING INFORMATION

SPECIFY:

1. Model Number (MCP101A)
2. Valving used (HPI or Berteau)
3. Accessories needed
4. LP/gas switch, if needed (optional on Berteau only).

ACCESSORIES AVAILABLE:

1. Switches
 2. Valving used (HPI or Berteau)
 3. Accessories needed
 4. LP/gas switch, if needed (optional on Berteau only).
 5. Exterior panel housing.
- (See Parts List for Ordering Numbers)

ORDER FROM:

HONEYWELL INC.
1885 Douglas Drive North
Minneapolis, Minnesota 55422
(612) 542-7397

DEVICE REPAIR

For devices in need of repair, be sure to include a description of the trouble, a copy of the purchase order and your name and address. Return to:

HONEYWELL INC.
Return Goods Department
550 39th Avenue NE
Minneapolis, Minnesota 55421

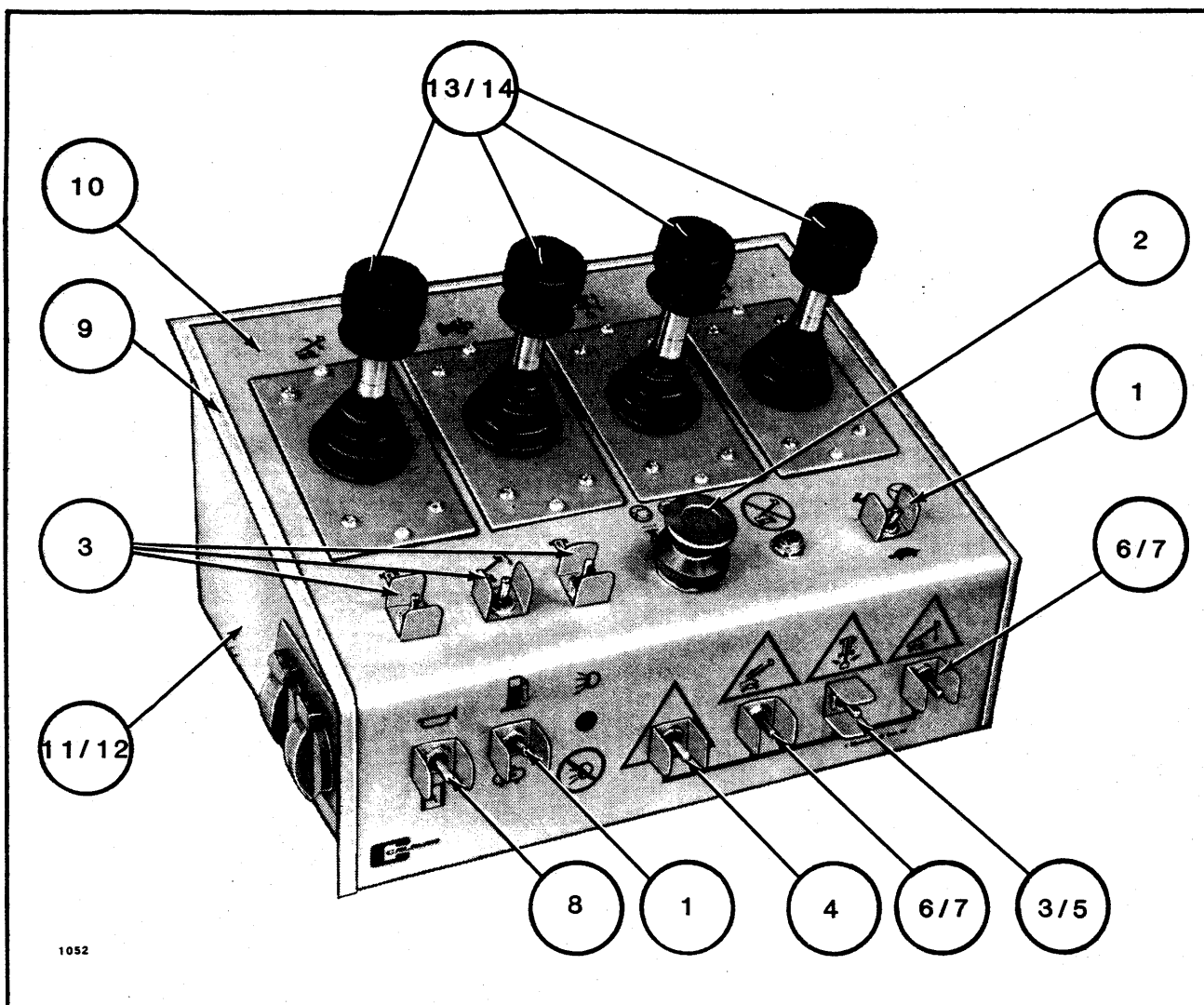


FIGURE 8. Numbered parts are identified under "Drawing Number" in the Parts List.



MCA100A Multi-Axis Tilt Alarm

BULLETIN 95-8954-2

APPLICATION

The MCA100A Multi-Axis Tilt Alarm provides a signal to the operator of self-propelled aerial lifts, cherry pickers, truck cranes, etc. that warns when the base vehicle is off level. When the alarm is tilted 4.5° from null the output signal activates both medium and high current alarms, sirens, bells or lights. The warning alarm indicates an imminent danger that must be rectified before work continues.

The Multi-Axis Tilt Alarm is easily mounted in a convenient location on the machine frame. It can be wired and leveled quickly and will provide years of trouble-free service.

FEATURES

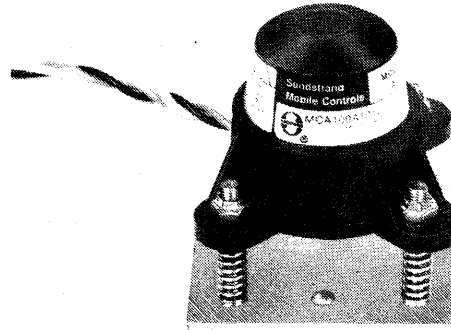
- Complies with ANSI aerial lift standard A 92.5
- High reliability with solid state load switching
- Easy to install
- LED simplifies leveling of time delayed alarms
- Damped response ignores normal machine vibrations
- Operates in either 12, 24 or 36 volt systems
- Time delay option available
- Reverse polarity and short circuit protected
- Tough housing withstands the elements
- Spring-loaded base allows for operational tests

SPECIFICATIONS

ELECTRICAL

POWER SUPPLY

- 11 to 30 Vdc (12/24 volt model)
- 24 to 40 Vdc (36 volt model)



WARNING

Alarms used in rechargeable battery-operated electrical systems will not sound if the system voltage drops below the input voltage rating for the relay to the alarm.

OUTPUT CURRENT

.2 amps, nominal; .5 amps, maximum

OUTPUT LOAD INDUCTANCE

.5 henries, maximum

SHORT CIRCUIT PROTECTION

Indefinite (output to ground or output to power supply).

LOAD SWITCHING RATE

60 cps maximum at rated inductance and current

TIME DELAYED (OPTIONAL)

2.5 \pm .5 seconds

ENVIRONMENTAL

OPERATING TEMPERATURE

-34° to $+71^\circ$ C (-30° to $+160^\circ$ F)

STORAGE TEMPERATURE

-34° to $+66^\circ$ C (-30° to $+150^\circ$ F)

SPECIFICATIONS (continued page 2)

SPECIFICATIONS (continued from page 1)

VIBRATION

Withstands a vibration test designed for mobile equipment controls that includes two parts:

1. Cycling from 5 to 2000 cycles in each of the three major axes.
2. Resonance dwell for one million Hz for each resonance point in each of the three major axes.

SHOCK

50 g for 11 milliseconds. Three shocks in both directions of the three major axes for a total of 18 shocks.

HUMIDITY

After being placed in a controlled atmosphere of 95% humidity at 120° F for 10 days the alarm will perform within specification limits.

RAIN

After being showered from all directions by a high pressure hose down the alarm will perform within specification limits.

EMI/RFI

Radiated fields of 10 volts per meter from 30 MHz to 200 MHz.

MECHANICAL

LIFE

10,000 operations at a single alarm point

DIFFERENTIAL

+1

9 -1.5° differential between diametrically opposite switch-on points.

For non-time delayed units, a maximum of 2.5 seconds and a minimum of .15 seconds from null to 6° tilt angle over a temperature range of -30° to 160° F.

For time delayed units, 2.5 ±.5 seconds (0° to 160° F) and 5.0 seconds or less (-30° to 0° F) from null to 6° tilt angle.

GENERAL

DIMENSIONS

See Figure 1.

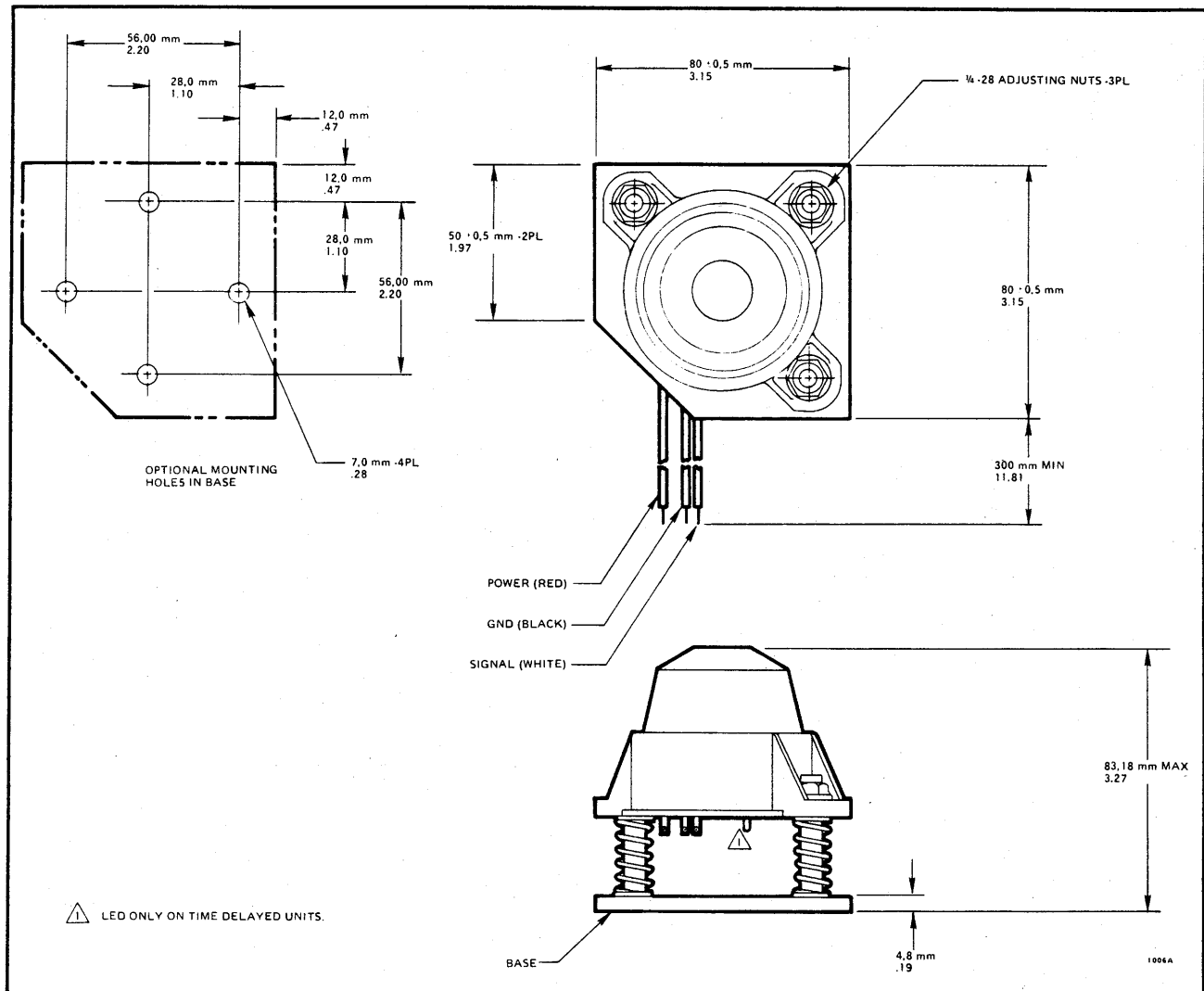


FIGURE 1. Dimensions of the MCA100A in millimeters (inches).

THEORY OF OPERATION

The Multi-Axis Tilt Alarm functions as a switch. It consists of a molded nylon housing containing a steel ball bearing, an incandescent lamp, a photo detector and a printed circuit board. The ball bearing is free to roll in a clear silicone damping fluid on a transparent, spherical basin. The bearing normally acts as an interruption between the lamp and the photo detector, but when the alarm is tilted 4.5° from horizontal the ball no longer blocks the light. The detector then receives the light and switches a VMOS transistor from a high impedance (OFF) to a low impedance (ON) state, activating the alarm. If the unit is time-delayed, an RC timing circuit is allowed to charge towards a threshold voltage before the transistor switches to the ON state. The timer is reset when the alarm is leveled back to less than 4.5° . Should the filament break, the circuit will close to warn the operator.

WARNING

In everyday use, some shaking of the machine's frame is to be expected. To prevent an intermittent alarm that would normally sound during use, the Tilt Alarm response is damped with silicone fluid. The resulting lag can be several seconds. Therefore, the alarm should not and can not be expected to give the operator sufficient warning time in dynamic movement situations. Angular boom and ground velocities should be kept to reasonable rates to ensure operator safety. Nor should the alarm be expected to warn the operator in the event of machine lurches due to untamped earth fills, ditches, drop-offs, holes, etc. Good safety practices demand a thorough inspection of the ground surrounding the vehicle base. When properly performed, this inspection should preclude possibilities of unforeseen machine movements.

INSTALLATION

WIRING

Three wires must be connected to put the Tilt Alarm in the alarm circuit. The red wire is the high (positive) side of the alarm, the black wire is the chassis ground and the white wire is the output lead. The Tilt Alarm and load are powered by 12, 24 or 36 volts.

In a very few applications, machinery equipped with the Tilt Alarm will be subjected to the high accelerations and decelerations associated with quick stops, starts and turns. Since its sensing principle responds to gravity, the alarm will also respond to these accelerations and trip the horn or light. In order to avoid annoying the operator with false alarms, the owners of tight-cornering and/or high-grounded-speed vehicles should interlock the operation of the Tilt Alarm with the work (as opposed to travel) mode. If the alarm has the time delay feature, this precaution is necessary.

Two typical wiring schemes are illustrated in Figures 2 and 3. Figure 3 uses a separate remote horn as the load. The horn should be a solid state device such as the Mallory SC616N with a volume of 80 db or better. It should draw no more than one-half amp. Figure 3 uses the vehicle's own alarm system (generally the horn) as the load. The horn relay should typically be from 200 to 600 ohms. Also pictured is the interlock switch.

MOUNTING

Three welds, one on each corner, are sufficient to mount the base for the Multi-Axis Tilt Alarm. Or the device can be bolted to the frame through the four-bolt pat-

tern on the base (see Figure 1). If the device is welded, the base should be detached from the housing and the alarm assembled subsequent to the mounting. This will avoid accidentally overheating the housing. Since the alarm is leveled after mounting, a smooth, flat weld is not critical for correct operation.

WARNING

The location of the mounting will vary from machine to machine. In all cases it should be on a level, horizontal area of the main frame. It should also be isolated from the operator (outside of the cab) but accessible for day-to-day use, **since the alarm should be field tested for proper working condition every day before the machine is run.**

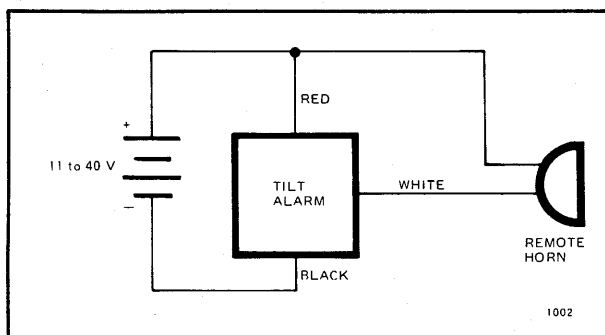


FIGURE 2. Wiring scheme using remote horn.

INSTALLATION (continued page 4)

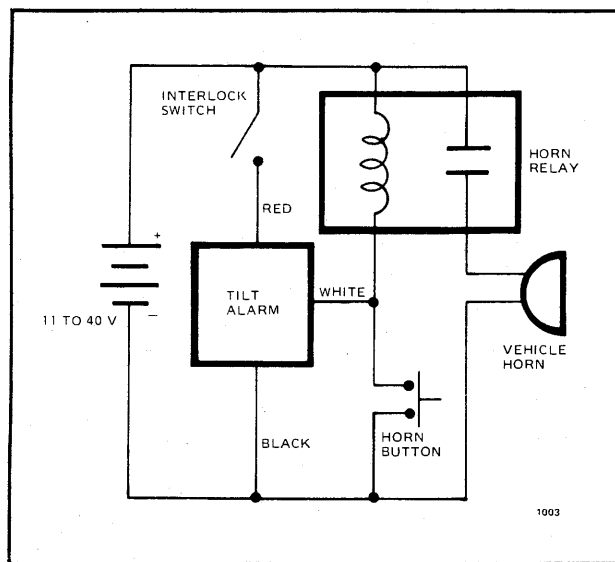


FIGURE 3. Wiring scheme using vehicle horn.

LEVELING

Use the following procedure to bring the Tilt Alarm into gravitational null:

- ☐ 1. Park the vehicle on a flat surface. Be sure it is as level as possible, with tires filled to rated pressure.

- ☐ 2. Level the base of the alarm by tightening the three flange nuts with a screwdriver-type socket wrench. Each nut should be tightened through approximately one half of its spring's travel. During the remainder of the procedure do not adjust the nut on the 90° corner.

- ☐ 3. With the electrical connections complete, slowly tighten the nut on one of the two corners adjacent to the 90° corner until the circuit is closed.

For non-time delayed units, the alarm will sound. For time delayed units, the LED on the underside of the housing will turn on.

- ☐ 4. Note the angular position of the socket. Loosen the nut, counting the number of turns until the circuit is closed again.

- ☐ 5. Divide this number in half. Tighten the nut by this many turns. The line determined by this nut and the nut on the 90° corner is now parallel to the ground.

- ☐ 6. Repeat steps 3 through 5 for the remaining nut. The alarm is now level.

- ☐ 7. Individually push down on one corner at a time; there should be enough travel to cause the alarm to trip. If the alarm does not trip in all three tests, the flange nuts have been tightened too far. Loosen the nut on the 90° corner and repeat steps 3 through 6. This push-to-test feature enables the operator to test the alarm without losing the alarm adjustment.

ORDERING INFORMATION

SPECIFY

Model name (MCA100A)

Input voltage (12, 24 or 36)

Instantaneous or time-delayed turn-on

For non-standard trip angles, or different trip angles in the X and Y axes, consult the Customer Service Department.

ORDER FROM

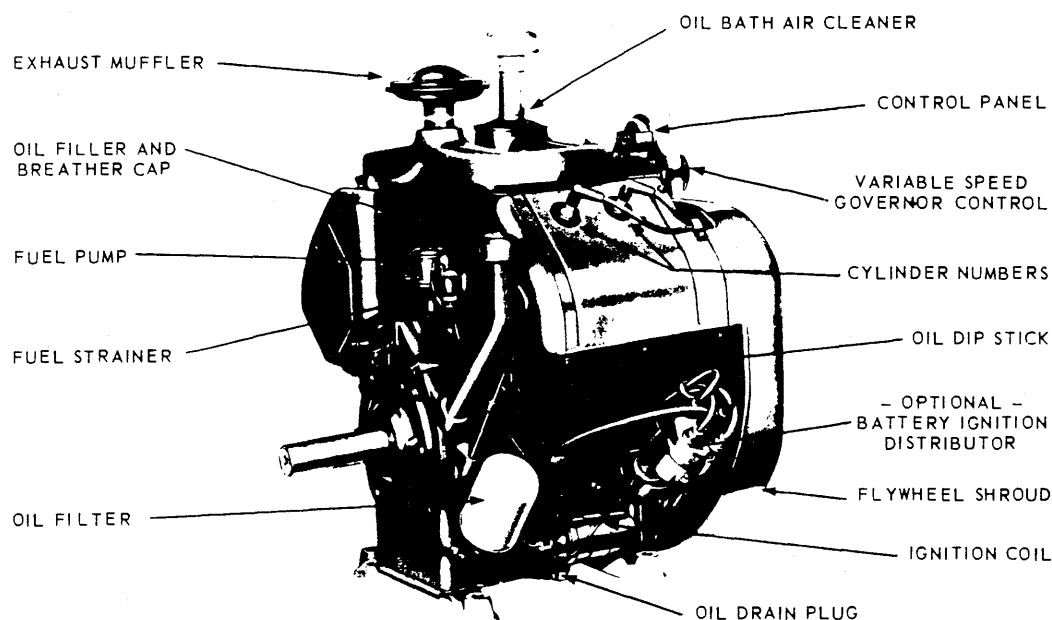
SUNSTRAND MOBILE CONTROLS
3900 Annapolis Lane North
Minneapolis, Minnesota 55441
(612) 559-2121

DEVICE REPAIR

For devices in need of repair, include a description of the problem, a copy of the purchase order and your name and address.

RETURN TO

SUNSTRAND MOBILE CONTROLS
Return Goods Department
3900 Annapolis Lane North
Minneapolis, Minnesota 55441

**STARTING and
OPERATING INSTRUCTIONS****W I S C O N S I N***Air-Cooled Engines*

OPEN ENGINE - TAKE-OFF VIEW

**Four Cylinder Engine
Models****VH4D • VG4D • V-465D****TELEDYNE WISCONSIN MOTOR**

WORLD'S FOREMOST SOURCE FOR HEAVY DUTY AIR COOLED ENGINES

INTRODUCTION

WISCONSIN heavy duty air cooled engines are of the most advanced design and are built in a modern factory, equipped with the latest machinery available. Only the best materials, most suitable for the particular part, are used. During production, every part is subjected to rigid inspection, as are also the completely assembled engines. After assembly, every engine is operated on its own power and all adjustments are carefully made so that each engine will be in perfect operating condition when it leaves the factory.

Teledyne Wisconsin Motor is backed by over 65 years of engineering experience in the design of internal combustion engines for every conceivable type of service. The performance of these engines is proof of the long satisfactory service you too can expect from your engine.

Like all fine machinery, the engine must be given regular care and be operated in accordance with the instructions.

SPECIFICATIONS

MODEL VH4D

Bore	3 1/4"
Stroke	3 1/4"
Piston Displacement — cu. in.	107.7
Horsepower — 1400 R.P.M.	17.2
1600 R.P.M.	20.0
1800 R.P.M.	22.5
2000 R.P.M.	24.7
2200 R.P.M.	26.5
2400 R.P.M.	28.0
2600 R.P.M.	29.2
2800 R.P.M.	30.0

MODEL VG4D

Bore	3 1/2"
Stroke	4 "
Piston Displacement — cu. in.	154
Horsepower — 1400 R.P.M.	25
1600 R.P.M.	29
1800 R.P.M.	32
2000 R.P.M.	34
2200 R.P.M.	36
2400 R.P.M.	37

MODEL V-465D

Bore	3 3/4"
Stroke	4 "
Piston Displacement — cu. in.	177
Horsepower — 1600 R.P.M.	41.6
1800 R.P.M.	47.5
2000 R.P.M.	52.4
2200 R.P.M.	56.7
2400 R.P.M.	60.0
2600 R.P.M.	63.0
2800 R.P.M.	64.5
3000 R.P.M.	65.9

Note: For continuous operation, allow 20% of horsepower shown, as a safety factor.

SAFETY PRECAUTIONS

- Never fill fuel tank while engine is running or hot; avoid the possibility of spilled fuel causing a fire.
- Always refuel slowly to avoid spillage.
- When starting engine, maintain a safe distance from moving parts of equipment.
- Do not start engine with clutch engaged.
- Do not spin hand crank when starting. Keep cranking components clean and free from conditions which might cause the crank jaw to bind and not release properly. Oil periodically to prevent rust.
- Never run engine with governor disconnected, or operate at load speeds in excess of: 2800 R.P.M. for model VH4D, 2400 R.P.M. for model VG4D and 3000 R.P.M. for model V-465D.
- Do not operate engine in a closed building unless the exhaust is piped outside. This exhaust contains carbon monoxide, a poisonous, odorless and invisible gas, which if breathed causes serious illness and possible death.
- Never make adjustments on machinery while it is connected to the engine without first removing the ignition cables from the spark plugs. Turning the machinery over by hand during adjusting or cleaning might start the engine and machinery with it, causing serious injury to the operator.
- Precaution is the best insurance against accidents.

NEW ENGINE Instructions

• LUBRICATION Operating without oil will ruin engine.

IMPORTANT

There is **NO OIL** in this unit.
Fill crankcase to proper oil level, also clutch or gear box if furnished, and oil bath air cleaner.

Refer to *GRADE OF OIL* chart (page 2) and fill with proper oil **before** starting engine.

• AIR CLEANER

Oil bath type — Add same grade oil as used in crankcase to the level line indicated on cleaner bowl. Maintain oil level or dirt will be drawn in and damage engine.

Dry element type, optional equipment — **DO NOT OIL** — Follow instructions on cleaner body.

• FUEL

Use *'REGULAR'* grade gasoline. Engines built to operate on FUEL OIL, KEROSENE, L.P.G. or NATURAL GAS are so identified in the model designation. Refer to *'FUEL'* paragraphs of instructions. Buy fresh fuel. Do not use *out-of-season* gasoline.

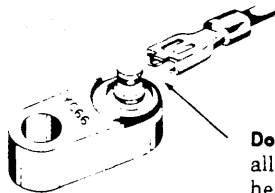
• NEGATIVE GROUND CIRCUIT , if engine is equipped with STARTING MOTOR, DISTRIBUTOR IGNITION and FLYWHEEL ALTERNATOR, or GENERATOR.



GROUND ENGINE TO NEGATIVE TERMINAL ON BATTERY.

CAUTION: Be absolutely sure of proper connection or damage to the Alternator or Generator circuits will result.

• PREVENT OVERHEATING



Temperature Safety Switch

Do not disconnect wire or allow terminal to touch head fins or shrouding.

Optional accessory mounted to cylinder head bolt near spark plug — **TO PROTECT ENGINE AGAINST OVERHEATING.** If engine stops, check first to see if engine is overheated. Other conditions may have caused the engine to stop. Clean air cleaner, air intake screen, fins, and check oil level, spark plugs and wiring. Let engine cool at least 10 minutes before restarting.

Keep Engine Clean

External dirt restricts cooling and internal dirt causes wear.

BREATHER CAP

Clean at every oil change

CYLINDER and HEAD COVERS

Remove and scrape dirt from cylinder and head fins.

OIL FILTER

Replace at least every other oil change.

VEE AREA

Remove dirt and chaff from manifold ports and space between CYL. blocks.

AIR CLEANER

Service daily if necessary

AIR INTAKE

Remove screen and brush clean.

• NEW ENGINE BREAK-IN

Proper *break-in* will lead to trouble-free operation and increased engine life. The factory test given to a new engine is not sufficient to establish the polished bearing surfaces which are so necessary for good performance and long engine life. There is no quick way to force the establishment of good bearing surfaces, and these can only be obtained by running a new engine carefully and under reduced

speeds and loads for a short period of time. Run the engine for a half hour without load at low idle speed (1000 to 1200 R.P.M.). The speed should then be increased gradually, to engine operating r.p.m. still without load, for an additional two hours. If at all possible, operate the engine at light loads for a period totaling about eight hours, before maximum load is applied.

FIGURE 01 WISCONSIN GASOLINE ENGINE

VENDOR - 01 - 02

STARTING AND OPERATING INSTRUCTIONS

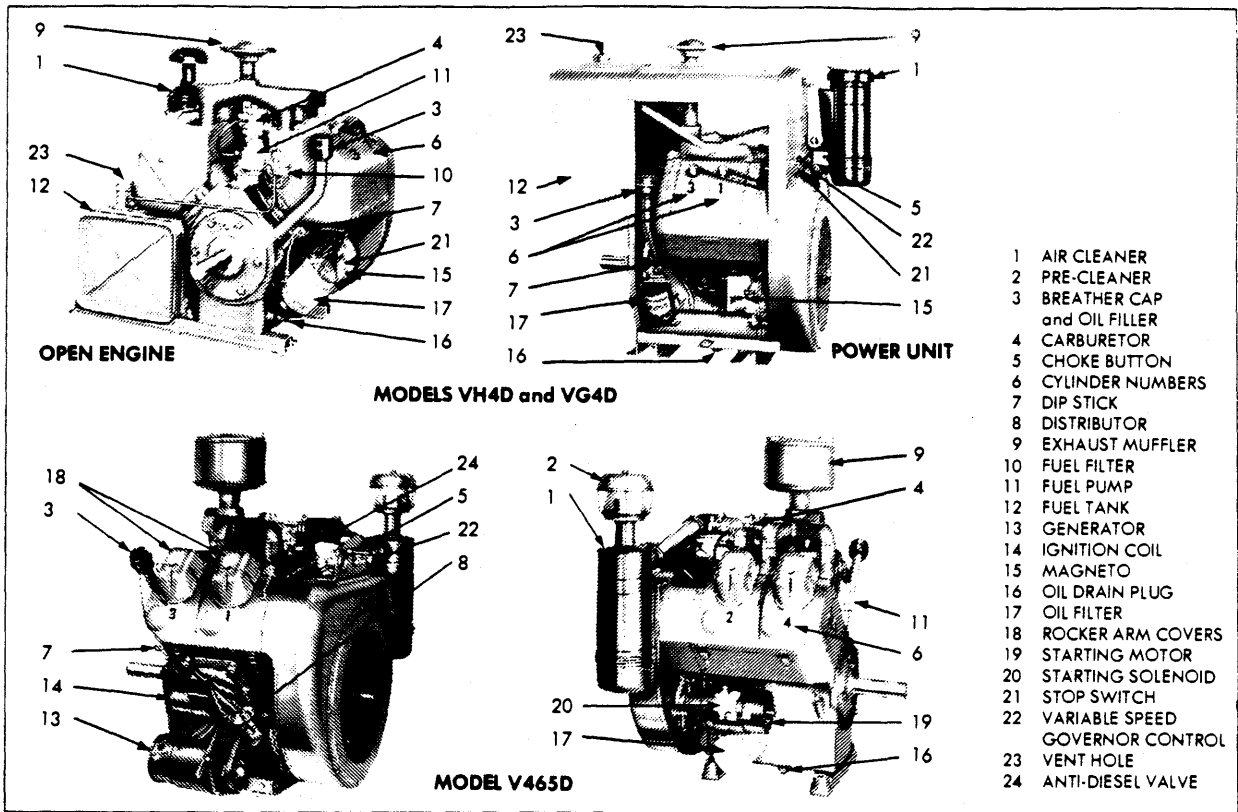


Fig. 1, REFERENCE VIEWS

GENERAL INFORMATION

These engines are of the four cycle type, in which each of the four operations of suction, compression, expansion and exhaust constitutes a complete stroke. This gives one power stroke per cylinder for each two revolutions of the crankshaft.

COOLING

Cooling is accomplished by a flow of air circulated over the cylinders and heads of the engine from a combination fan-flywheel encased in a sheet metal shroud. The air is divided and directed by ducts and baffles to insure uniform cooling of all parts.

NEVER OPERATE AN ENGINE WITH ANY PART OF THE SHROUding REMOVED — this will retard air cooling.

IGNITION

The spark for ignition of the fuel mixture is furnished by a high tension magneto driven by the timing gears at crankshaft speed (models VH4D and VG4D).

Battery ignition (12 volt) distributor, is furnished in place of magneto on engines equipped with flywheel alternator, or as optional ignition (Std. on model V-465D).

ROTATION

The rotation of the crankshaft is clockwise when viewing from the flywheel or front end of the engine, and counterclockwise rotation of the power takeoff or rear end of the engine.

BEFORE STARTING NEW ENGINE

1. Fill tank with Regular grade gasoline.

OIL BURNING engine has letter 'O' suffixed to model designation — use 35 minimum octane fuel oil.

L.P.G. BURNING engine has letter 'G' added to model designation — use propane HD5.

NATURAL GAS burning engines require a B.T.U. content of at least 1000.

2. Fill crankcase base with the proper grade of engine oil as specified in "GRADE OF OIL" chart. Fill through the breather tube opening to the level indicated by the FULL mark on DIPSTICK.

For run-in of new engines, use same oil as recommended in GRADE OF OIL chart.

Check crankcase oil level every 8 hours, change oil every 50 hours of operation.

To change oil, remove drain plug from oil pan. Oil should be drained while engine is hot; it will flow more freely.

3. Clutch and gear reduction unit lubrication differs between the various engine models. All units operating in oil are furnished with oil filler, level and drain plugs, suitable for any take-off shaft position.

GRADE OF OIL

SEASON OR TEMPERATURE	GRADE OF OIL		
Spring, Summer or Autumn +120°F to +40°F	SAE 30		
Winter +40°F to +15°F +15°F to 0°F Below 0°F	SAE 20-20W SAE 10W SAE 5W-20		
Use oils classified as Service MS, SD or SE			
Crankcase Capacity	VH4D	VG4D	V465D
New Engine	3½ qts.	4½ qts.	6 qts.
Oil and filter change	4 qts.	5 qts.	7 qts.
Less — oil filter or filter change	3½ qts.	4½ qts.	6 qts.

Model VH4D, Fig 2 and Fig. 3:

Fill clutch and gear reduction units to the height of the oil level plug opening. Use same grade oil as used in engine crankcase. Add sufficient oil between changes to keep oil up to the level plug opening.

Change oil in clutch and reduction units at least every 500 hours of operation.

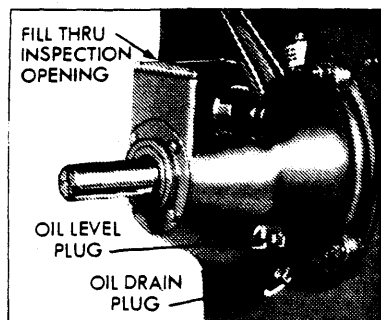


Fig. 2, VH4D
CLUTCH LUBRICATION

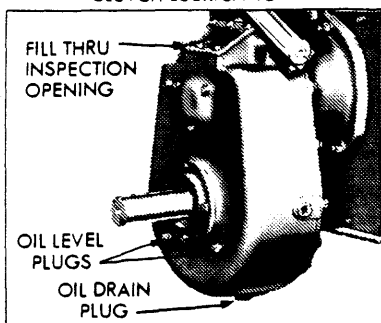


Fig. 3, VH4D
CLUTCH REDUCTION LUBRICATION

Models VG4D and V465, Fig. 4 and Fig. 5:

The clutch in both the power take-off and clutch reduction units is of the dry disc type, therefore NO OIL should be put into the clutch housing. Grease fittings are provided for periodic lubrication of the bearings. The HOUSING BEARING should be greased every 50 hours of operation, and the THROWOUT BEARING every day before starting. Use Mobil Gargoyle grease BRB No. 3, Sinclair AF-1 grease, or equal.

The PILOT BEARING is sealed and requires no external lubrication.

The SHIFTER SHAFT should be lubricated periodically if external oil fittings are provided.

THE REDUCTION UNIT IS OPERATED IN OIL and the gear case oil level must be maintained to the oil DIPSTICK mark or PLUG opening, which ever is applicable. In ROCKFORD units use No. 30 S.A.E. crankcase oil, for TWIN DISC units use

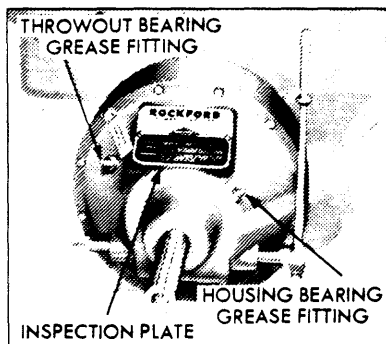


Fig. 4, VG4D, V465D
CLUTCH LUBRICATION

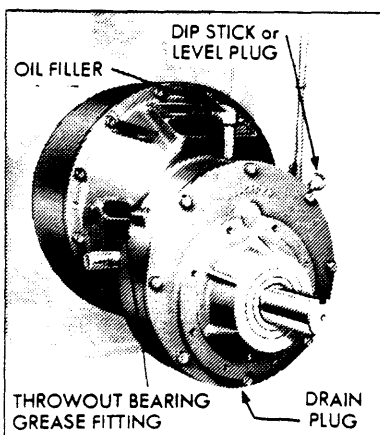


Fig. 5, VG4D, V465D
CLUTCH REDUCTION LUBRICATION

high grade transmission oil, S.A.E. No. 90 to No. 110 viscosity. Change oil every 500 hours of service, while unit is warm.

STARTING

With reference to Fig. 1: Engines enclosed in a sheet metal house are referred to as Power Units, whereas those without a house are called Open Engines.

Power Unit side doors should always be removed when operating.

STARTING PROCEDURE Fig.'s 6, 7, 8

1. Check crankcase oil level and gasoline supply. Open shut-off valve in fuel strainer.

OIL BURNING engines must be started on gasoline and run for 2 or 3 minutes before switching to oil. Special instructions are available for starting L.P.G. and NATURAL GAS burning engines.

2. Disengage clutch, if furnished.
3. Prime new engine — if necessary, see Fig. 6. Hand primer lever at fuel pump (available option), should be worked back and forth until strainer bowl is full — then an additional 5 or 10 strokes to fill carburetor bowl. If primer does not function — turn crankshaft one complete revolution.

Gravity feed (power units), and electric start engines do not require priming.

4. Set throttle about 1/2 open if variable speed governor control is furnished. With a two speed control, start in full load position — idle after engine starts.

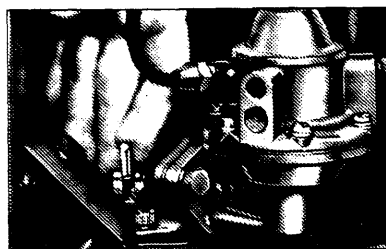


Fig. 6, FUEL PUMP PRIMER

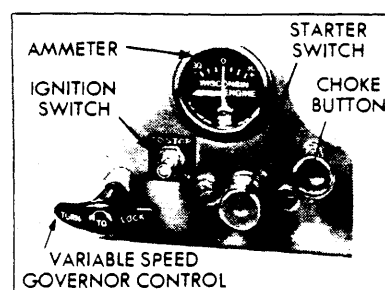


Fig. 7, VH4D, VG4D
CONTROL PANEL

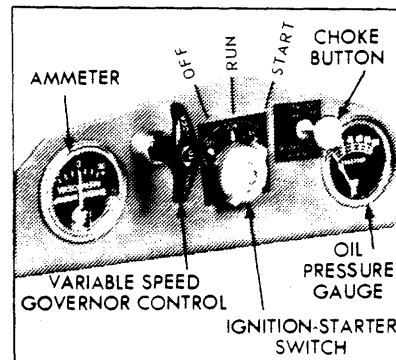


Fig. 8, V465D
CONTROL PANEL

Models VH4D and VG4D only, Fig. 7

5. Pull out ignition switch, if applicable (tag reads "TO STOP PUSH IN").

Magneto ignition engines (less ignition switch), have a lever type ground switch on side of magneto which is always in the ON or running position, except when depressed for stopping.

- 5a. Close choke by pulling choke button to extreme out position.

- 5b. Turn engine over slowly one or two revolutions. CAUTION: Be sure that crank does not bind — apply oil to the crank jaw and crank nut extension for ease of engagement and release.

Push choke control button in about halfway and then pull up rapidly on the starting crank. Do not attempt to spin the engine with the starting crank. If engine does not start on the first pull up of the crank, re-engage the crank and repeat the operation.

With electric starting motor; depress starter switch button in place of hand cranking. See Fig. 7.

- 5c. After engine starts, push choke button in as required for smooth running. Choke should be completely open (button in), when engine is warmed up.

Less choking is necessary in warm weather or when engine is warm, than when cold. Should flooding occur, open choke fully and continue cranking.

Model V465D only, Fig. 8

6. After setting throttle as per paragraph 4. Turn IGNITION-STARTING SWITCH to 'Start' position and at the same time pull out choke button only sufficient to start the engine.

6a. Release choke button to open position after engine starts, but rechoke if it tends to stop. **EVEN A HOT ENGINE REQUIRES MOMENTARY CHOKING WHEN STARTING.** When engine starts release switch to 'RUN' position.

If flooding should occur, continue cranking with the starting motor, but with the choke open (choke button in).

WARM-UP

If all conditions are right, engine will start promptly in one or two attempts. After engine starts, allow it to warm up a few minutes before applying load. Do not race or gun engine to hurry WARM-UP. The proper oil film on various surfaces of the pistons, cylinders, bearings, etc., cannot be established until the oil has warmed up and become sufficiently fluid. Break-in new engine per instructions on page 1.

TO STOP ENGINE

Magneto ignition (open engines) have a lever type ground switch on the side of the magneto. **DEPRESS AND HOLD DOWN UNTIL ENGINE STOPS.** See Fig. 1, Ref. 21.

Power units and battery ignition, Fig. 7, are furnished with an ignition switch, **"TO STOP PUSH IN"**.

Model V465D; turn **IGNITION-STARTING SWITCH** to OFF position. See Fig. 8.

If engine has been running hard and is hot, do not stop it abruptly from full load. Remove the load and allow the engine to run idle (1000 to 1200 R.P.M.), for 3 to 5 minutes. Air circulation from the flywheel will reduce the temperature of the engine much faster and minimize valve warping.

MAINTENANCE

AIR CLEANERS

The air cleaner is an essential accessory, filtering the air entering the carburetor and preventing abrasive dirt from entering the engine and wearing out valves and piston rings in a very short time.

The air cleaner must be serviced frequently, depending on the dust conditions in which the engine is operated. Check hose connections for leaks or breaks and replace all broken or damaged hose clamps.

Excessive smoke or loss of power are good indications that the air cleaner requires attention.

OIL BATH AIR CLEANER, Fig. 9

Service daily; or twice a day if engine is operating in very dusty conditions. Once each week; in comparatively clean conditions.

Remove oil cup from bottom of air cleaner and clean thoroughly. Add the same grade of oil, as used in the engine crankcase, to the **LEVEL LINE** indicated on the oil cup.

Operating the engine under dusty conditions without oil in the air cleaner or with dirty oil, may wear out cylinders, pistons, rings and bearings in just a few days time.

Once a year; or oftener if conditions are severe, the air cleaner should be removed

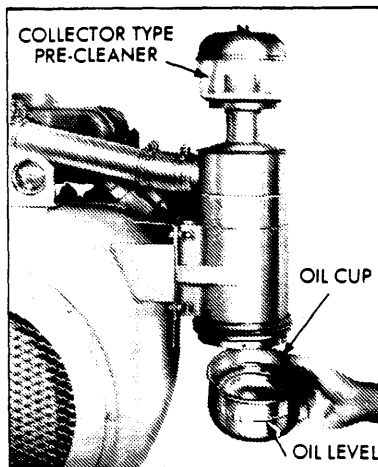


Fig. 9 OIL BATH AIR CLEANER

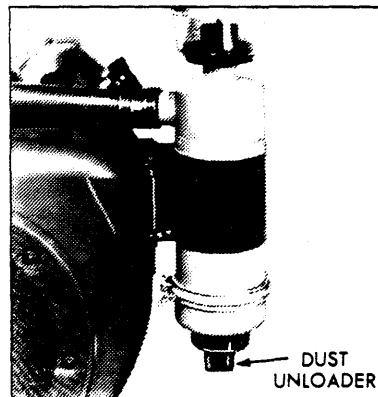


Fig. 10, DRY TYPE AIR CLEANER

from the engine and the element, which is not removable, should be washed in a solvent to clean out accumulated dust and dirt.

DRY TYPE AIR CLEANER, Fig. 10

Service daily; squeeze rubber dust unloader once or twice a day to check for possible obstruction. If engine is operating in very dusty conditions, remove cartridge and shake out the accumulated dirt (do not tap or strike element — it may become damaged). Wipe out dirt from inside cover and bowl, after removing baffle and dumping out dust.

Once each week; the filtering cartridge should be taken out and rinsed under a faucet with cold water, then wash by repeated dippings for several minutes in a solution of lukewarm water and a mild, **NON-SUDSING** detergent. Rinse in cold water from the inside out, and allow to dry overnight before re-installing. In cold weather, protect element from freezing until dry.

DO NOT USE GASOLINE, KEROSENE OR SOLVENT — DO NOT OIL ELEMENT.

After ten washings or one year of service, replace cartridge. New cartridges are available at your **TELEDYNE WISCONSIN MOTOR Service Center.**

PRE-CLEANER

The collector type pre-cleaner, mounted to the top of the air cleaner as illustrated in Fig. 9, removes the larger dirt and dust particles before the air reaches the main air cleaner.

Clean bowl regularly of accumulated dust and dirt. Do not put oil or water in pre-cleaner, this must be kept dry.

BREATHING CAP, Fig. 1, Ref. 3

The crankcase is ventilated thru a breather cap mounted to the top of the oil filler tube. At every oil change, it is recommended that the cap be cleaned by washing in kerosene.

DISTRIBUTOR, Fig. 1, Ref. 8

If engine is equipped with battery ignition distributor:

Every 250 hours of operation; add 3 to 5 drops of medium engine oil to the oiler on side of distributor base.

Every 250 hours, apply 3 to 5 drops of light engine oil (10W), to the felt in the top of the cam sleeve, and 1 or 2 drops to the breaker arm pivot.

Every 250 hours, add a small amount of high melting point grease to the breaker arm rubbing block.

Avoid excessive lubrication. Oil on the contact points will cause them to burn.

GENERATOR - Belt Driver, Fig. 1, Ref. 13

Every 50 hours of operation; add 3 to 5 drops of medium engine oil into the oil cups at both ends of the generator.

FUEL FILTER, Fig. 11

It is very important that the fuel be filtered to prevent sediment, dirt and water from entering the carburetor and causing trouble or even complete stoppage of the engine. The glass filter bowl should be inspected frequently, and cleaned if dirt or water are present.

To remove sediment bowl, loosen nut below bowl, swing bail to one side and twist bowl as it is being removed. Clean screen and bowl thoroughly — replace gasket if it is damaged or hardened.

OIL FILTER, Fig. 1, Ref. 17

A **BY-PASS** type oil filter is furnished on all Model VH4D and VG4D engines, except where the use of other accessories prevent mounting an oil filter.

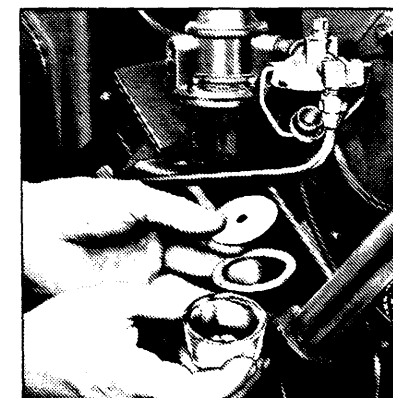


Fig. 11, FUEL FILTER

FIGURE 01 WISCONSIN GASOLINE ENGINE

VENDOR - 01 - 05

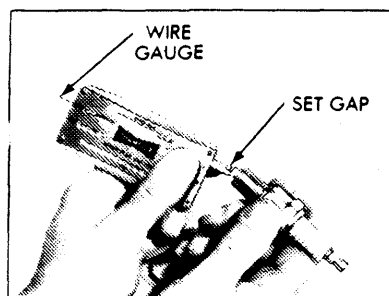


Fig. 12

A FULL-FLOW oil filter is furnished on model V465D engines as standard equipment. Since all of the circulated oil passes thru the filter, it is very important that it be serviced regularly.

The oil filtering cartridge should be replaced after EVERY OTHER OIL CHANGE. If operating conditions are extremely dusty, replace cartridge after every oil change. Use only Wisconsin Micro-Fine or Full-Flo oil filter cartridges from your nearby Teledyne Wisconsin Motor Service Center.

SPARK PLUGS, Fig. 12

Incorrect gap, fouled or worn spark plug electrodes, will have an adverse affect on engine operation. Remove spark plugs periodically — clean, regap or replace if necessary.

Spark plug gap - .030 inch.

Use new spark plugs at the beginning of a new season. Replacement plug must be of the correct heat range, equal to:

Model	Thread Size	Make
VH4D	18mm	Champion D-16J
VG4D		(Wisconsin YD-6)
V465D	14mm	Champion N-12Y
		(Wisconsin YD-301)

Torque spark plugs 25 to 30 foot pounds for Models VH4D, VG4D, and to 22 foot pounds for Model V465D.

STARTING MOTOR, Fig. 1, Ref. 19

No maintenance is required other than keeping the outside of the starting motor clean, and periodic inspection for insecure mounting and loose or corroded cable connections.

In extreme dust and dirt conditions it may be necessary to occasionally remove the starter from the engine and clean the Bendix by brushing with Kerosene. Do not oil Bendix.

ADJUSTMENTS

CARBURETOR

The carburetor MAIN METERING JET is of the fixed type and therefore no adjustment is necessary.

The correct amount of throttle plate opening for the proper low idle speed is obtained by means of the THROTTLE STOP SCREW. However, this is set at the factory

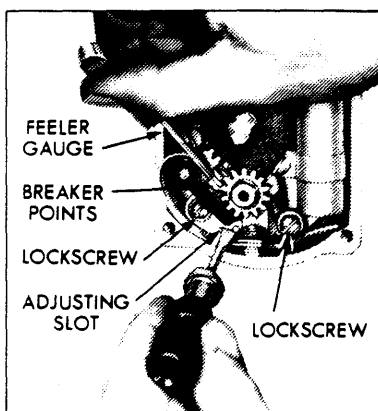


Fig. 13

so that no immediate adjustment is necessary. The IDLE ADJUSTMENT is for smooth low speed operation and this adjustment, if necessary, must be made with the carburetor throttle lever closed. Initial setting is approximately 1½ turns open.

MAGNETO BREAKER POINTS, Fig. 13

At least once each season or when ignition spark becomes weak, remove magneto end cover, inspect points and check gap opening. If there is evidence of pitting or pyramiding and it becomes necessary to resurface or replace points, it will also be necessary to readjust the gap clearance. The BREAKER POINT GAP should be:

.015 inch at full separation.

Turn engine crankshaft over until breaker points are at their maximum opening. Loosen the two lockscrews on breaker plate just enough so that plate can be moved. Place a 0.015 inch feeler gauge between points. Insert end of small screw driver into adjusting slot at bottom of breaker plate and open or close the contacts by moving plate until a slight drag is felt when sliding the feeler gauge from between the points. Tighten lockscrews and recheck point gap.

Before placing end cover on frame, clean contact surfaces, coat with gasket cement and mount new gasket. Assemble cover, rotor and end cap.

DISTRIBUTOR (Battery Ignition), Fig. 14

The breaker point gap should be:

.020 inch at full separation.

To readjust point gap, turn engine over by means of the hand crank until the distrib-

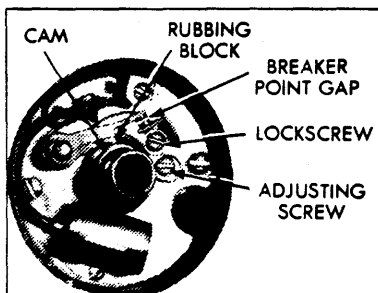


Fig. 14

utor breaker arm RUBBING BLOCK is on a high point of the CAM. Loosen the stationary contact LOCKSCREW slightly and insert a feeler gauge between the points. By means of a screw driver, turn ADJUSTING SCREW until correct gap is obtained. Tighten lockscrew and recheck gap.

Points that are badly pitted or worn should be replaced.

VALVE TAPPET ADJUSTMENT

Models VH4D, VG4D, Fig. 15

With the tappets in their lowest position (valves completely closed) and engine cold, the clearance between valve stem and tappet adjusting screw should be:

Inlet - .008" Exhaust - .016"

The inlet valves are to the inside of the cylinder block, the exhaust valves are toward the outside. Place feeler gauge between valve stem and tappet screw, and adjust clearance by means of two ½ inch tappet wrenches.

Model V465D, Fig. 16

The clearance between the valve and rocker arm, with the tappet in its lowest position (valve completely closed) and the engine cold.

Inlet - .008" Exhaust - .014"

The rocker arms can be identified as follows: When facing toward the side of the engine, the Exhaust Rocker Arm is to the right in the cylinder head and the inlet rocker arm to the left.

Measure clearance between the top of the valve and nose of rocker arm with a feeler

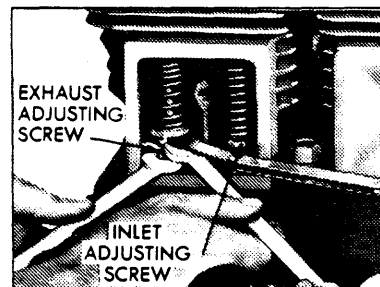


Fig. 15, VH4D, VG4D
VALVE TAPPET ADJUSTMENT

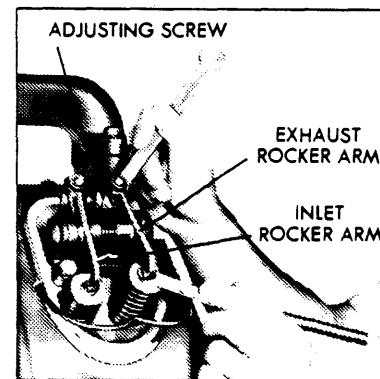


Fig. 16, V465D
VALVE TAPPET ADJUSTMENT

gauge as shown. By means of a 1/4 inch tap-pet wrench, turn the adjusting screw clockwise to decrease valve clearance and counter-clockwise to increase the clearance.

The sequence in which the tappets are adjusted is determined by the 1-3-4-2 firing order. Start by adjusting No. 1 inlet valve clearance first, then by just a short turn of the crank, No. 3 inlet can be adjusted. Return to No. 1 cylinder and adjust the exhaust clearance, then adjust the No. 3 exhaust.

The same procedure applies to the No. 2 and No. 4 bank of cylinders, starting with No. 4 inlet valve. Mark each rocker arm with chalk as adjustment is completed, to prevent repetition.

TIMING

FIRING ORDER

The firing order of the cylinders is 1-3-4-2, and the magneto or distributor rotor turns at one-half engine speed, as is the case with conventional 'In Line' engines.

The intervals between the firing of the cylinders is 180°. No. 1 cylinder is the one nearest to the flywheel in the left bank of cylinders, when viewed from the flywheel end of the engine. No. 3 cylinder is the other cylinder in this bank. No. 2 cylinder is the one nearest to the flywheel in the right bank of cylinders and No. 4 is the other cylinder in this bank. The cylinders are numbered on the head covers.

Note: When disconnecting ignition wires, mark cap, and tag wires for correct re-assembly.

TIMING CHECK, Fig. 17

The running spark advance for both magneto and battery ignition, is 23°, and timing must be checked with the engine running at 2000 R.P.M. or over.

Insert a small screw driver into the No. 1 terminal tower on the distributor cap, making contact with the ignition wire terminal. Connect the red terminal clip, from an automotive Timing Light to the metal part of the

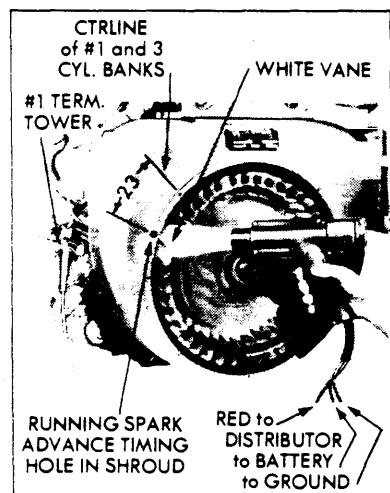


Fig. 17

screw driver. Connect the other two wires of the timing light; one to the positive side of the battery, the other to ground. Chalk or paint the end of the 'X' marked vane of the flywheel, white. Then, with the engine operating at 2000 r.p.m. or over, allow the flash from the timing light to illuminate the white vane. At the time of the flash the leading edge of the vane should line up with the running spark advance timing hole in the front face of the flywheel shroud.

Note: Timing can be checked without removing flywheel shroud screen (Fig. 17 shows screen removed), by illuminating leading edge of white vane with timing light thru the 3/8" diameter hole in rim face of flywheel screen.

Timing Adjustment for either battery or magneto ignition: Refer to the INSTRUCTION and PARTS MANUAL of the specific engine model for adjustment procedure.

CLUTCH ADJUSTMENT

If the clutch begins to slip, it should be readjusted to prevent it from becoming overheated and damaged. First, remove inspection plate to expose the adjusting ring. Release clutch by pushing shifter lever forward (toward engine).

VH4D Clutch, Fig. 18

Turn engine over by means of the starting crank until clutch adjustment lock is visible thru the inspection opening. Loosen adjustment lock screw one full turn. Keep clutch from turning by securing the crankshaft at cranking end. Then, by means of a screw driver, turn adjusting ring one notch at a time in a clockwise direction, until a very firm pressure is required when engaging the clutch shifter lever, and as the clutch snaps into engaged position. Securely tighten adjustment lock screw.

VH4D CLUTCH REDUCTION, Fig. 19

The clutch in the clutch reduction unit is the same as used in the power take-off unit and is adjusted thru two pipe tap openings; one for the adjustment lock screw and the other for turning the adjusting ring. If one of the taps is inaccessible, adjustment can be made thru just one opening by rotating clutch slightly after adjustment lock screw

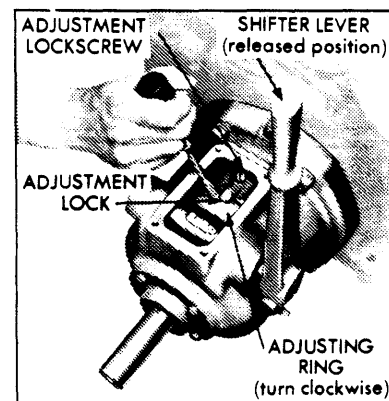


Fig. 18, VH4D CLUTCH ADJUSTMENT

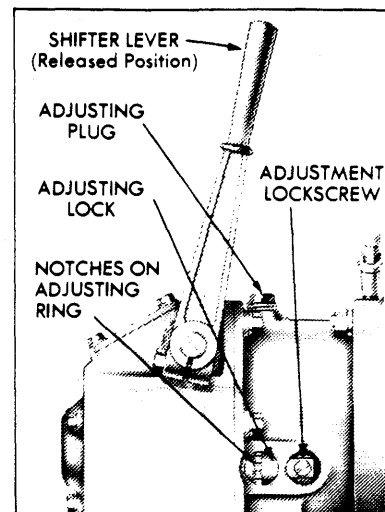


Fig. 19, VH4D CLUTCH REDUCTION ADJUSTMENT

is loosened. Follow adjustment procedures as outlined in preceding paragraph.

VG4D, V465D CLUTCH ADJUSTMENT

Rockford Clutch Fig. 20: After removing the inspection cover and disengaging clutch with the shifter lever, turn engine over by means of the hand crank, until the clutch adjustment lock is visible thru the inspection opening in the clutch housing. Prevent take-off shaft from turning by means of a drift punch wedged in place as shown. Then, loosen the lock screw holding the adjustment lock in place. Insert a screwdriver in one of the notches and turn the adjusting ring, in a counter-clockwise direction, one notch at a time, until a very firm pressure is required to engage the clutch with the shifter lever. Tighten adjusting lock screw and mount inspection cover.

TWIN DISC CLUTCH, Fig. 21: Pull adjusting lockpin out and insert a piece of 1/16" diameter wire into the hole on the side of the lockpin to keep pin in outer position. Turn the adjusting yoke in a clockwise direction

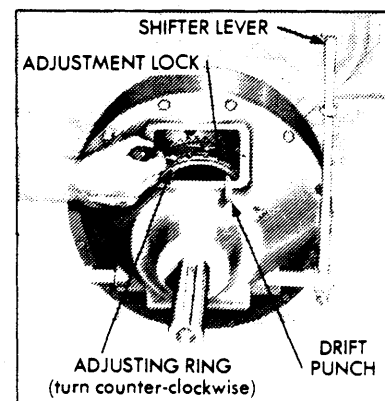


Fig. 20, VG4D, V465D ROCKFORD CLUTCH ADJUSTMENT

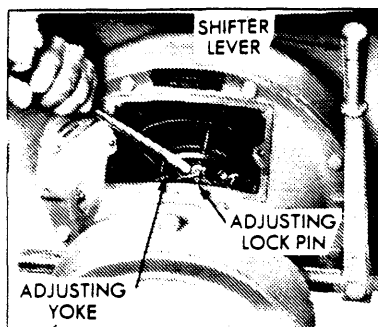


Fig. 21, VG4D, V465D
TWIN DISC CLUTCH ADJUSTMENT

as shown, or wedge a screw driver into the adjusting yoke and against the side of the inspection hole openings to keep the yoke from turning, then turn the take-off shaft counter-clockwise to adjust yoke enough so that the shifter lever requires a distinct pressure to engage. Remove wire from lock-pin and turn adjusting yoke slightly, to allow lockpin to snap into hole in floating plate.

A new clutch generally requires several adjustments until the friction surfaces are worn in. Do Not let a new clutch slip, this will ruin the friction surfaces.

FLYWHEEL ALTERNATOR

Fig. 22 and Fig. 23

12 Volt - 10 Amp or 25 Amp Flywheel Alternator, consisting of a flywheel with Magnetic Rotor, Stator and Rectifier-Regulator modules, is optional equipment on models VH4D and VG4D-furnished when battery ignition is required. There are no brushes, commutator or belts to contend with and no adjustments are necessary.

Since the physical appearance of both 10 amp and 25 amp alternator systems are very similar, they can be distinguished from each other by the ammeter calibrations; 0 to 15 amps for the 10 amp circuit and 0 to 30 amps for the 25 amp circuit.

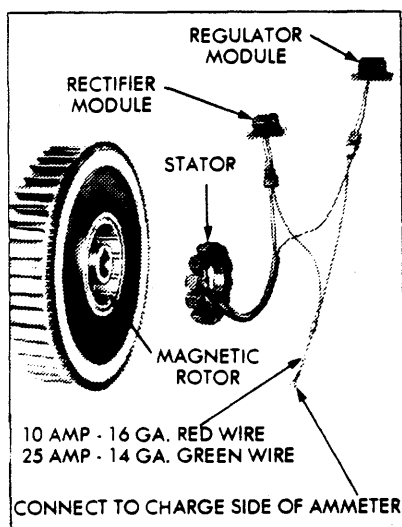


Fig. 22, FLYWHEEL ALTERNATOR

PRECAUTIONS to be exercised in the use of this flywheel alternator:

1. Do not reverse battery connections. This is a negative ground system only.
2. Connect booster batteries — positive to positive and negative to negative.
3. Do not polarize the alternator.
4. Do not ground any wires from stator or modules which terminate at connectors.
5. Do not operate engine with battery disconnected from system.

6. Disconnect at least one battery lead if a battery charger is used.

GENERATOR — WIRING CIRCUIT, Fig. 24

The model V465D engine is equipped with a 12 volt-17 amp generator in a negative ground electrical system. Do not reverse polarity-damage to both generator and regulator will occur. Engine will not operate with carburetor anti-diesel solenoid wire disconnected.

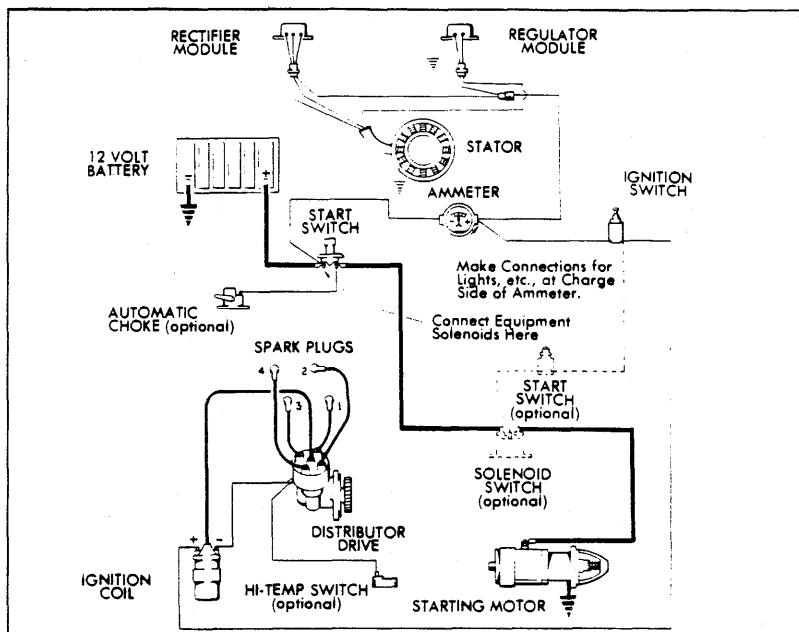


Fig. 23, WIRING DIAGRAM, Flywheel Alternator and Battery Ignition, Models VH4D, VG4D

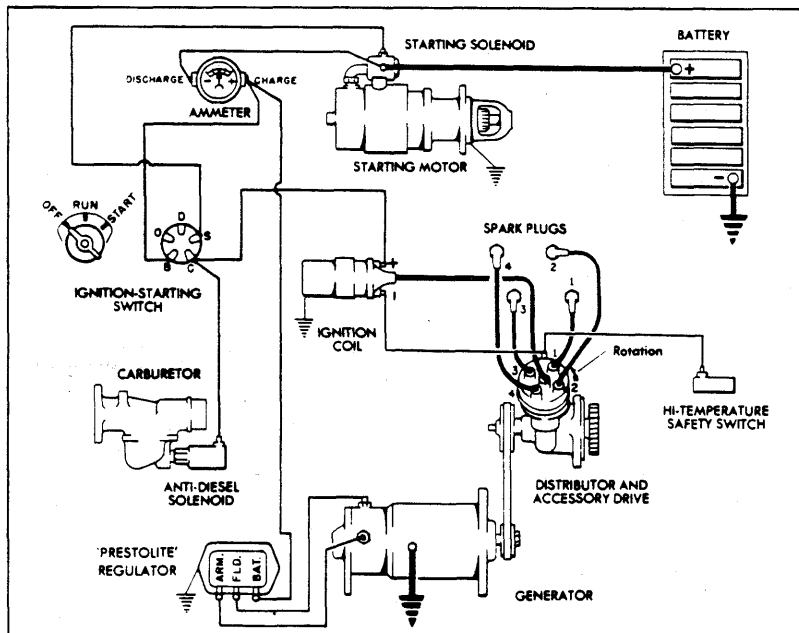


Fig. 24, WIRING DIAGRAM, Generator and Battery Ignition, Model V465D

FIGURE 01 WISCONSIN GASOLINE ENGINE

VENDOR - 01 - 08

TROUBLE SHOOTING

The three prime requisites essential to starting and maintaining satisfactory operation of internal combustion engines are:

1. A proper fuel mixture in the cylinder.
2. Good compression in the cylinder.
3. Good spark, properly timed, to ignite the mixture.

If all three of these conditions do not exist the engine cannot be started.

As a guide to locating some of the difficulties in starting, causes are listed under the three main headings of:

Fuel Mixture, Compression, and Ignition.

FUEL MIXTURE

No fuel in tank or fuel valve closed.

Plugged vent hole in fuel tank cap.

Fuel line clogged.

Fuel pump diaphragm worn or punctured.

Anti-diesel solenoid valve at carburetor inoperative (model V465D).

Check for disconnected, loose or broken wire.

Carburetor not choked sufficiently, especially if engine is cold.

Water, dirt, or gum in gasoline interfering with free flow of fuel to carburetor.

Poor grade, stale or out-of-season gasoline.

Carburetor flooded, caused by too much choking especially if engine is hot.

Carburetor float needle valve stuck open. This condition would be indicated if fuel

continues to drip from carburetor with engine standing idle.

COMPRESSION

Cylinders dry due to engine having been out of use. Pour one fluid ounce of crankcase oil through spark plug holes.

Loose or broken spark plug. A hissing noise will be heard in cranking due to escaping gas mixture on compression stroke.

Damaged cylinder head gasket or loose cylinder head. This will likewise cause hissing noise on compression stroke.

Valve stuck open. Piston rings stuck or worn.

Valves adjusted with insufficient clearance.

IGNITION

Test for spark by removing spark plugs and observe spark at plug gap while turning engine over. No spark or weak spark may be attributed to the following:

Ignition wires loose or disconnected at magneto, spark plug, distributor or coil.

Broken or frayed ignition wires.

Spark plug insulator broken.

Spark plugs wet or dirty.

Spark plug gap incorrect.

Condensation on spark plug electrodes.

Breaker point gap incorrect.

Breaker points pitted or fused.

Breaker arm sticking.

Condenser leaking or grounded.

Spark timing wrong.

Weak battery. Faulty ignition coil.

ENGINE MISSES

Spark plug gap incorrect.

Worn, leaking or loose ignition cables.

Weak spark. See 'Ignition' test for spark.

Breaker points pitted or worn.

Water in gasoline.

Poor compression. See 'Compression'.

Sticky valves.

ENGINE STOPS

Fuel tank empty.

Water, dirt or gum in gasoline.

Gasoline vaporized in fuel lines, due to excessive heat around engine (Vapor Lock). See 'Stopping Engine'.

Vapor lock in fuel lines due to using winter gas (too volatile) in hot weather.

Air vent hole in fuel tank cap plugged.

Ignition troubles. See 'Ignition'.

OVERHEATING

Crankcase oil supply low.

Ignition timing wrong.

Low grade of gasoline.

Engine overloaded.

Restricted cooling air circulation.

Part of air shroud removed from engine.

Dirt between cooling fins.

Intake or rotating screen clogged with dirt.

Restricted exhaust.

ENGINE MAINTENANCE SCHEDULE	Page Ref.	Daily	Weekly or 50 hrs.	100 hrs.	250 hrs.	Seasonally or 500 hrs.
CHECK OIL LEVEL. Add to full mark - Do not overfill.	2	●				
CHECK AIR CLEANER. Shake out accumulated dirt from dry element cleaner - Maintain oil level in oil bath type cleaner.	4	●				
CLEAN AIR INTAKE SCREEN. Clean cooling fins if necessary.	1	●				
GREASE CLUTCH THROWOUT BEARING (VG4D, V465D).	3	●				
CHANGE CRANKCASE OIL.	2		●			
CLEAN AIR FILTER ELEMENT. DRY Element and OIL Bath types.	4		●			
CLEAN CRANKCASE BREATHER CAP.	4		●			
GREASE CLUTCH HOUSING BEARING (VG4D, V465D).	3		●			
REPLACE OIL FILTER. In adverse conditions replace every oil change.	4			●		
LUBRICATE DISTRIBUTOR SHAFT.	4				●	
CHECK COMPRESSION. Pressure should not vary more than 10 p.s.i. between cylinders. Remove head - clean out carbon deposits. Reseat valves if necessary.	-				●	
INSPECT SPARK PLUGS and BREAKER POINTS. Replace if necessary and regap to specification.	5				●	
INSPECT FUEL FILTER. Clean filter screen and glass bowl.	4				●	
LUBRICATE DISTRIBUTOR CAM and breaker arm pivot.	4				●	
INSPECT COOLING SYSTEM. Remove shrouding and scrape off dirt from between fins, around cylinders and from shrouding.	1				●	
INSPECT STARTING MOTOR. Check for loose mounting and cable connections.	5				●	
CHANGE OIL IN CLUTCH and REDUCTION GEAR HOUSINGS.	2					●

Limited Engine Warranty

TELEDYNE WISCONSIN MOTOR, herein referred to as 'Teledyne Wisconsin', warrants each new Wisconsin 4-cycle air-cooled engine sold by Teledyne Total Power to be free from defects in material and workmanship, under normal use and service, for a period of one (1) year (except in the case of an engine used on any recreational type vehicle the period shall be ninety (90) days) after the date of delivery to the original retail purchaser, and Teledyne Wisconsin will, at its option, replace or repair, at one of Teledyne Wisconsin's factories, or at a point designated by Teledyne Wisconsin, any part or parts which shall appear to the satisfaction of Teledyne Wisconsin upon inspection at such point, to have been defective in material or workmanship. This warranty does not obligate Teledyne Wisconsin to bear any transportation charges in connection with the replacement or repair of defective parts.

This Warranty shall not apply to any engine which shall have been installed or used in a manner not recommended by Teledyne Wisconsin, nor to any engine which shall have been repaired, altered, used in any type of competition, nor operated other than within Teledyne Wisconsin Motor specified limits, neglected or used in any way which, in Teledyne Wisconsin's opinion, adversely affects its performance; nor to any engine in which parts not approved by Teledyne Wisconsin have been used; nor to any accessories installed on the engine where the accessory manufacturer has its own warranty; nor to normal maintenance services or replacement of normal service items.

Teledyne Wisconsin reserves the right to modify, alter, and improve any engine or parts without incurring any obligation to replace any engine or parts previously sold with such modified, altered, or improved engine or parts.

THIS WARRANTY, AND TELEDYNE WISCONSIN'S OBLIGATION HEREUNDER, IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER OBLIGATIONS OR LIABILITIES, INCLUDING SPECIAL OR CONSEQUENTIAL DAMAGES OR CONTINGENT LIABILITIES ARISING OUT OF THE FAILURE OF ANY ENGINE OR PART TO OPERATE PROPERLY. No person is authorized to give any other warranty or to assume any additional obligation on Teledyne Wisconsin's behalf unless made in writing and signed by an officer of Teledyne Wisconsin.

 **TELEDYNE WISCONSIN MOTOR**

cut along dotted line

Individual INSTRUCTION and SERVICE PARTS MANUAL available from all Wisconsin Distributors,

return to
TELEDYNE TOTAL POWER
3409 DEMOCRAT ROAD
MEMPHIS, TENNESSEE 38118

Dear Customer:

If you would like to receive a free copy of a list of Authorized Teledyne Wisconsin Motor DISTRIBUTORS and SERVICE CENTERS in your area, please complete the following:

NAME _____

STREET _____

CITY _____ STATE _____ ZIP _____

ENGINE MODEL _____ SERIAL NO. _____

FIGURE 01 WISCONSIN GASOLINE ENGINE

VENDOR - 01 - 10